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Morrisons
43-67 High Street
Yiewsley

Proposed Mixed Use Retail and Residential Development

Energy Strategy

Planning

Client Name:	Habourside Investments Ltd and WM Morrison Supermarkets PLC
Property:	Morrisons 43-67 High Street Yiewsley UB7 7QQ
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EXECUTIVE SUMMARY

This energy strategy adopts a hierarchical approach using passive and low energy design technologies to reduce baseline energy demand and CO_2 emissions of the development followed by the application of low and zero carbon technologies. This strategy is in line with the relevant London Borough of Hillingdon and GLA Policies from the London Plan and the related supplementary guidance. In accordance with the April 2014 issue of the GLA SPG 'Sustainable Design and Construction' the target carbon emission savings for this energy strategy are for zero carbon homes in relation to Part L1A: 2013. For the retail unit and landlords common parts a 35% improvement over Part L2A: 2013 is targeted.

The focus of this energy strategy is on CO_2 reduction by using a highly efficient building envelope with high efficiency mechanical and electrical services, along with a CHP system and photovoltaic cell renewable technology across the development. The result is a proposed development with predicted performance of:

- CO_2 reduction of 35.52% over the Building Regulations 2013 compliant baseline scheme for the apartments only
- CO_2 reduction of 30.81% over the Building Regulations 2013 compliant baseline scheme for the entire development when apartments, the retail unit and landlord areas are taken into account.
- When unregulated uses are taken into account there is a predicted reduction of 14.74% in the development's annual CO_2 emissions.
- The use of PV panels are predicted to achieve a 15.39% CO_2 reduction based on regulated uses for the apartments.
- The energy strategy is predicted using the Building Regulations calculation methodologies to achieve an annual carbon emission saving of 88.19 tonnes over the baseline scheme for the development

The carbon dioxide emission and savings values for the development as a whole are as follows:

	CO_2 Emissions (Tonnes per annum)	
	Regulated	**Unregulated**
Baseline Building Regulations 2013 / Part L Compliant Development	286.28	598.36
After passive/low energy (energy demand) reduction	227.97	540.05
After CHP or decentralised heating	214.60	526.69
After renewable energy	198.09	510.18

	Regulated CO_2 Savings	
	Tonnes per annum	**%**
Savings from passive/low energy (energy demand) reduction	58.31	20.37
Savings from CHP or decentralised heating	13.36	5.86
Savings from renewable energy	16.51	7.69
Total Cumulative Savings	**88.19**	**30.81**

	Annual Shortfall (Tonnes CO_2)	**Cumulative 30 Year Shortfall (Tonnes CO_2)**
Annual shortfall from zero carbon target	103.51	3105.3

The regulated annual carbon emission shortfall when compared to the zero carbon target for the apartments and a 35% reduction for the landlord and retail unit is 103.51 tonnes CO_2 so allowing an assumed 30 year duration for the development services this equates to a cumulative shortfall of 3105.3 tonnes of CO_2.

This is the maximum saving achievable given the constraints of the site and agreed building form, plus the retail unit is assessed without the benefit of the tenant's actual mechanical and electrical services design (that is not available in time for the planning application however it will most likely be more efficient than the minimum Building Regulations allowances that have had to be made).

1.00 INTRODUCTION

1.01 Purpose

This report has been prepared on behalf of Harbourside Investments Ltd and WM Morrison Supermarkets PLC for the proposed development at Morrisons, 43-67 High Street Yiewsley. The report contains the predicated energy and carbon emission assessment results and identifies savings from proposed low and zero carbon (renewable) technologies to be incorporated into the scheme.

The energy and carbon dioxide emission assessment has been undertaken using dynamic simulation modelling software TAS Version 9.4.3 for the retail unit and landlord common parts and SAP version 6.3.4 for the residential apartments. Based on the building design submitted with the planning application the modelling has identified the energy and carbon dioxide savings related to the building envelope design and efficient mechanical and electrical services systems followed by the improvement using the proposed low and zero carbon (renewable) technologies for the scheme.

1.02 Existing Building

The existing buildings at the site will be demolished and replaced by the new development.

1.03 Proposed Development

This report accompanies the planning application for the demolition of the existing buildings and the redevelopment of the site to provide a retail and residential mixed use scheme. The site will be developed to provide a replacement Morrisons foodstore, with 144 residential units provided above.

1.04 Reservation

This report has been prepared solely for the use of Harbourside Investments Ltd and WM Morrison Supermarkets PLC and Watkins Payne Partnership accept no responsibility for its use by any third parties.

2.00 POLICY REVIEW

2.01 National Policy

The National Planning Policy Framework sets out the planning policies for England that are to be taken into account as a material consideration. The framework itself does not have specific energy related policies but identifies the purpose of achieving sustainable development.

2.02 London Plan (Consolidated with Alterations since 2011) 2016

The London Plan 2016 identifies key policies associated with building design and energy strategy as noted below:

Policy 5.2 Minimising Carbon Dioxide Emissions

Planning Decisions

A Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1 Be lean: use less energy

2 Be clean: supply energy efficiently

3 Be green: use renewable energy

B The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outline in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Domestic Buildings:

Year	***Improvement on 2010 Building Regulations***
2010 – 2013	*25 per cent*
2013 – 2016	*40 per cent*
2016 – 2031	*Zero carbon*

C Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D As a minimum, energy assessments should include the following details:

a) Calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy

b) Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services

c) *Proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as decentralised heating and cooling and combined heat and power (CHP)*

d) *Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies*

E *The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.*

Policy 5.5 Decentralised Energy Networks

Strategic

A *The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.*

Policy 5.6 Decentralised Energy in Development Proposals

Planning Decisions

A *Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.*

B *Major development proposals should select energy systems in accordance with the following hierarchy:*

1. *Connection to existing heating or cooling networks.*
2. *Site wide CHP network.*
3. *Communal heating and cooling.*

C *Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.*

Policy 5.7 Renewable Energy

Strategic

A *The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.*

Policy 5.9 Overheating and Cooling

Strategic

A The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

Planning Decisions

B Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. *Minimise internal heat generation through energy efficient design*
2. *Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls*
3. *Manage the heat within the building through exposed internal thermal mass and high ceilings*
4. *Passive ventilation*
5. *Mechanical ventilation*
6. *Active cooling systems (ensuring they are the lowest carbon options)*

C Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible.

2.03 GLA Supplementary Planning Guidance

The London Plan (Consolidated with Alterations since 2011) 2016 is supported by various supplementary planning guidance (SPG) that includes "Sustainable Design and Construction" dated April 2014 that relates specifically to sustainability issues.

The Sustainable Design and Construction SPG sets out the Mayor's priorities and the Mayor's best practice for new developments encompassing a wide range of sustainability topics.

The relevant sections from the Sustainable Design and Construction SPG are as follows:

Energy and Carbon Dioxide Emissions	
Mayor's Priority	**London Plan Policy**
The overall carbon dioxide emissions from a development should be minimized through the implementation of the energy hierarchy set out in the FALP 2016 Policy 5.2.	5.2, 5.3
Developments should be designed to meet the following Regulated carbon dioxide standards, in line with MALP 2016 Policy 5.2.	5.2
Domestic Buildings • Year - Improvements beyond 2010 Building Regulations. • 1st October 2013 – 2016 – 40 per cent • 2016 – 2031 – Zero carbon	5.2

Mayor's Best Practice	**London Plan Policy**
Developments should contribute to ensuring resilient energy infrastructure and a reliable energy supply, including from local low and zero carbon sources.	5.1, 5.5, 5.6, 5.7, 5.8, 5.17
Developers are encouraged to include innovative low and zero carbon technologies to minimize carbon dioxide emissions within developments and keep up to date with rapidly improving technologies.	5.2, 5.17
Energy Demand Assessment	
Mayor's Priority	**London Plan Policy**
Development applications are to be accompanied by an energy demand assessment.	5.2
Use Less Energy	
Mayor's Priority	**London Plan Policy**
The design of developments should prioritise passive measures.	5.2, 5.3, 5.9
Mayor's Best Practice	**London Plan Policy**
Developers should aim to achieve Part L 2013 Building Regulations requirements through design and energy efficiency alone, as far as is practical.	5.2, 5.3
Efficient Energy Supply	
Mayor's Priority	**London Plan Policy**
Where borough heat maps have identified district heating opportunities, boroughs should prepare more detailed Energy Master Plans (EMPs) to establish the extent of market competitive district heating networks.	5.5, 5.6
Mayor's Priority	**London Plan Policy**
Developers should assess the potential for their development to: • connect to an existing district heating or cooling network; • expand an existing district heating or cooling network, and connect to it; or • establish a site wide network, and enable the connection of existing buildings in the vicinity of the development.	5.5, 5.6
Mayor's Priority	**London Plan Policy**
Where opportunities arise, developers generating energy or waste heat should maximize long term carbon dioxide savings by feeding the decentralized energy network with low or zero carbon hot, and where required, cold water.	5.5, 5.6
Renewable Energy	
Mayor's Priority	**London Plan Policy**
Boroughs and neighbourhoods should identify opportunities for the installation of renewable energy technologies in their boroughs and neighbourhoods.	5.4, 5.7
Major development should incorporate renewable energy technologies to minimize overall carbon dioxide emissions, where feasible.	5.7

Carbon Dioxide Off-setting	
Mayor's Priority	**London Plan Policy**
Boroughs should establish a carbon off-set fund and identify suitable projects to be funded.	5.2, 5.4
Where developments do not achieve the Mayor's carbon dioxide reduction targets set out in MALP 2016 Policy 5.2, the developer should make a contribution to the local borough's carbon dioxide off-setting fund.	5.2, 5.4
Retrofitting	
Mayor's Priority	**London Plan Policy**
Boroughs should set out policies to encourage the retrofitting of carbon dioxide and water saving measures in their borough.	5.4, 5.15
Where works to existing developments are proposed developers should retrofit carbon dioxide and water saving measures.	5.4, 5.15
Monitoring Energy Use	
Mayor's Best Practice	**London Plan Policy**
Developers are encouraged to incorporate monitoring equipment and systems where appropriate to enable occupiers to monitor and reduce their energy use.	5.2, 5.3
Supporting a Resilient Energy Supply	
Mayor's Best Practice	**London Plan Policy**
Developers are encouraged to incorporate equipment that would enable their schemes to participate in demand side response opportunities.	5.2, 5.3
Climate Change Adaptation	
Tackling Increased Temperature and Drought	
Overheating	
Mayor's Priority	**London Plan Policy**
Developers should include measures, in the design of their schemes, in line with the cooling hierarchy set out in MALP 2016 Policy 5.9 to prevent overheating over the schemes life-time.	5.3, 5.9

2.04 London Borough of Hillingdon

The London Borough of Hillingdon Local Plan Part 1 adopted in November 2012 key policies associated with climate change adaptation and mitigation as noted below:

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.
2. Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.

3. Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.
4. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.
5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.
6. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
7. Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
8. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydro-electricity and a greater use of waste as a resource.
9. Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

10. Locating and designing development to minimise the probability and impacts of flooding
11. Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water consumption.
12. Giving preference to development of previously developed land to avoid the loss of further green areas.
13. Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amounted of carbon sinks.
14. Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.

3.00 ENERGY STRATEGY METHODOLOGY

3.01 Energy Strategy

The fundamental approach adopted for this energy strategy is as follows:

- Establish the baseline energy demand in line with statutory requirements in terms of Building Regulations Part L1A:2013 compliance using SAP calculations for a sample of apartment types across the development of different sizes and oritentations.
- Establish the baseline energy demand in line with statutory requirements in terms of Building Regulations Part L2A: 2013 compliance using accredited thermal modelling software for the retail unit and landlords common areas.
- Adopt passive and low energy design techniques in order to reduce the energy demand for the development beyond the baseline energy demand requirements.
- Assess the potential use of decentralised heating, cooling and power.
- Assess the potential use of site wide district heating type network.
- Assess the potential low and zero carbon (renewable) technologies to suit the development and establish potential energy/carbon dioxide reduction for viable solutions.
- Establish the anticipated energy and carbon dioxide emission reductions for the development using Building Regulations 2013 calculations methodology.

This approach is in line with the principles detailed within the relevant policy statements and regulatory guidelines listed in section 2.00.

It should be noted that the strategy will have to use minimum Building Regulations efficiency parameters for the retail unit as the tenant's mechanical and electrical services design is not available in time for the planning application.

Also as the retail unit tenant has its own bespoke heating, cooling and ventilation requirements it is not practicable to link the retail unit into a central energy centre type solution being proposed for the residential element.

3.02 Energy Strategy Targets

The target carbon emission savings for this energy strategy are 35 % less than the Building Regulations Part L2A:2013 baseline for the retail unit and common areas in addition to 100% less than the Building Regulations Part L1A: 2013 baseline for the residential apartments.

3.03 Overheating

The approach adopted for the residential apartment overheating analysis is in line with CIBSE TM52 as defined in the "Energy Planning – GLA Guidance on preparing energy assessments: (March 2016)". The approach will also take into account GLA guidance on climate change and designing to mitigate overheating in extremes of temperature which may be expected in years to come. This will be achieved using design summer years of 1976, 1989 and 2003 and use guidance set out in CIBSE TM49.

In April 2017 CIBSE released TM59 which provides specific guidance and criteria for residential accommodation to assist in reducing the risk of overheating however this report has used the GLA guidance adopting the TM52 assessment methodology.

4.00 ENERGY DEMAND ASSESSMENT

4.01 General

4.01.01 Principles

The energy demand work associated with the apartments has been undertaken using Elmhurst Energy SAP software version 6.3.4 which incorporates calculations set out in the SAP 2012 document in order to establish a carbon dioxide emission rate in line with Part L1A: 2013.

The energy demand assessment work associated with the retail unit and landlords common areas has been undertaken using EDSL TAS dynamic simulation software Version 9.4.3 that incorporates the SBEM calculation methodology in line with Building Regulations Part L2A:2013 requirements in order to generate a predicted annual CO_2 emission rate.

Within the energy demand assessment the following fuel carbon dioxide emission intensity factors have been used in line with Building Regulations.

Fuel	kg CO_2 / kWhr
Natural gas	0.216
Grid supplied electricity	0.519
Grid displaced electricity	0.519

4.01.02 Regulated and Un-regulated Energy

The Energy Strategy is provided in a format that reflects the recommendations of the GLA document “Energy Planning – GLA Guidance on preparing energy assessments: (March 2016)”.

Therefore this energy strategy shows how policy compliance for the “regulated” energy can be achieved at the development and makes reference to the estimated “un-regulated” energy usage by means of energy benchmarks.

For clarity “regulated” and “un-regulated” energy are summarised as follows:

- Regulated Energy — This is the energy covered by Approved Documents L1A and L2A of the Building Regulations i.e. the energy used in heating, cooling, fans and pumps plus domestic hot water
- Un-regulated Energy — This is energy used within a building that is not covered by the Building Regulations i.e. the energy used for general small power loads, lifts, external lighting, catering electricity, etc.

The London Plan planning policy CO_2 reduction targets are based on “regulated” energy only. Hence the % CO_2 emission savings target is not adversely affected by the estimated “un-regulated” energy in a building.

The unregulated energy use assessment for the apartments is based upon the principles defined within the SAP software calculation procedure Section 16 that principally accounts for energy usage from appliances and cooking equipment.

The assessed un-regulated energy uses for the proposed retail units and landlord common areas are as follows:

- General small power
- Lifts
- External lighting
- Catering electricity
- Catering gas

4.01.03 Energy Benchmarks

4.01.03.01 Residential Apartments

The value from Section 16 of the SAP software which takes into account energy usage from appliances and cooking equipment has been converted into an area weighted value that for all the apartments equates to 19.01 kg CO_2/m^2/year.

4.01.03.02 Retail Units and Landlords Common Areas

The "un-regulated" energy use and benchmarks for this energy strategy have been derived from data and guidance taken from the following Chartered Institute of Building Services Engineers (CIBSE) documents:

1. CIBSE Guide F – Energy Efficiency in Buildings: 2012
2. CIBSE Technical Memorandum – Energy Benchmarks TM46: 2008

The un-regulated energy use values have been derived from the CIBSE Guide F Benchmark Section. The most appropriate specific benchmarks used and resultant estimated un-regulated energy values are as follows:

Mixed use — Standard mixed use buildings of 25 kWh/m^2/year that equates to 13.00 $kgCO_2/m^2$

4.02 Baseline Scheme

4.02.01 Residential Apartments

For the purpose of the baseline scheme the SAP assessment has been undertaken on an individual apartment basis (for the sample of apartments used) and then combined on an area weighted basis to give an estimated overall residential development CO_2 emission rate. These apartments are assessed in line with Part L1A: 2013 where the notional apartment (TER) form the baseline scheme.

The baseline scheme carbon emissions for the target emission rate (TER) from the SAP assessment are as follows:

	Baseline CO_2 Emission (kg CO_2/ m^2/year)
	Area Weighted Total
Part L1A:2013 DER	**14.92**
Unregulated Uses	19.01
Total	**33.93**

For a full list of the emissions from each selected apartment type please refer to Appendix 1 of this document.

The annual apartment CO_2 emissions resulting from the baseline demand equates to 140.77 tonnes CO_2 when unregulated energy are not taken into account and 320.13 tonnes CO_2 when unregulated energy uses are taken into account.

4.02.02 Retail Unit and Landlords Common Areas

The baseline demand is the Building Regulations Part L2A:2013 target emission rate (TER).

The Part L2A:2013 TER is derived from the thermal model based on the National Calculation Methodology (NCM). The review has been carried out utilising the TAS dynamic thermal modelling software version 9.4.3 that has achieved accreditation from the Department of Communities and Local Government (DCLG).

The building has had the retail unit and landlords common parts modelled and baseline CO_2 emissions for the different uses are as follows:

Retail Unit

	CO_2 Emission (kg CO_2/ m²/year)
	Retail Unit
Heating	1.91
Cooling	15.62
Fans and pumps	1.55
Lighting	19.48
Domestic Hot Water	0.43
Part L2A: 2013 TER	**38.99**
Unregulated Uses	13.00
Total	**51.99**

The annual retail unit CO_2 emissions resulting from the baseline demand equates to 61.17 tonnes CO_2 without unregulated energy and 81.56 tonnes CO_2 with it.

Landlords Common Areas

	CO_2 Emission (kg CO_2/ m²/year)
	Landlords Common Areas
Heating	0.68
Cooling	0.00
Fans and pumps	0.62
Lighting	8.46
Domestic Hot Water	0.00
Part L2A: 2013 TER	**9.76**
Unregulated Uses	13.00
Total	**22.76**

The annual landlords areas CO_2 emissions resulting from the baseline demand equates to 84.38 tonnes CO_2 without unregulated energy and 196.67 tonnes CO_2 with it.

4.02.03 Development

The annual CO_2 emissions resulting from the baseline demand across the development equates to the following:

	CO_2 Emission	
	(kg CO_2/ m^2/year)	Tonnes CO_2/ m^2/year
	Development	Development
Without Unregulated Uses	14.57	286.28
With Unregulated Uses	30.46	598.36

4.03 Energy Efficiency Measures

4.03.01 General

The energy strategy prioritises the reduction in energy consumption and hence CO_2 emissions through the building envelope design together with the use of efficient mechanical and electrical services.

The passive and low energy design principles that have been adopted in the current design include:

- High performance glazing
- Improved building fabric thermal insulation.
- Low building air leakage rate ($3m^3/hr/m^2$ at 50 Pa which represents a 70 % improvement over the minimum 2013 Building Regulations requirements).
- High efficiency gas fired boilers.
- Community heating system serving all apartments.
- Whole house mechanical supply and extract ventilation systems in each apartment with integral heat recovery.
- Variable speed fans and pumps.
- Low energy lighting (LED lamp sources) with PIR occupancy control.
- Comprehensive energy management system.

The thermal properties used in the thermal model analysis are as follows:

- External wall U value = 0.15 W/ m^2K.
- Residential glazing U/G/LT = 1.3 / 0.50 / 0.75.
- Retail unit glazing U/G/LT = 1.5 / 0.40 / 0.71
- Roof U value = 0.12 W/m^2K.
- Ground & exposed floors U value = 0.2 W/ m^2K.

Note all U-value parameters stated above are area weighted figures.

4.03.02 Residential Apartments

The Building Regulations SAP calculations identify the following CO_2 emissions for the residential apartments incorporating the energy efficiency measures:

	CO_2 Emission (kg CO_2/ m^2/year)	
	Area Weighted Total	
	Baseline	**Lean**
Part L1A:2013 DER	**14.92**	**12.55**
Unregulated Uses	19.01	19.01
Total	**33.93**	**31.56**

For a full list of the lean emissions from each selected apartment type please refer to Appendix 1 of this document.

The comparison of the energy efficient scheme against the baseline scheme identifies that for the residential areas there is a predicted 15.88% (Part L1A: 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 6.98% (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Lean Part L1A:2013
Without unregulated uses	118.41
With unregulated uses	297.77

The residential apartments have been assessed in terms of overheating within Section 7.00 of this report. This assessment assumes the use of openable windows to mitigate overheating and provides residents with a comfortable environment without the need for comfort cooling. Elements of the overheating analysis (G-value of the glass etc.) have been undertaken in parallel with the carbon emissions analysis work as these directly have an effect on one another.

4.03.03 Retail Unit

The Building Regulations thermal model analysis identifies the following CO_2 emissions for the retail unit only incorporating energy efficiency measures:

	CO_2 Emission (kg CO_2/ m^2/year)	
	Retail Unit	
	Baseline	**Lean**
Heating	1.91	1.19
Cooling	15.62	14.48
Fans and pumps	1.55	2.67
Lighting	19.48	18.37
Domestic Hot Water	0.43	0.58
Part L2A: 2013 TER	**38.99**	**37.39**

	CO_2 Emission (kg CO_2/ m^2/year)	
	Retail Unit	
Unregulated Uses	13.00	13.00
Total	**51.99**	**50.39**

The comparison of the energy efficient scheme against the baseline scheme identifies that for the retail unit there is a predicted area weighted 4.09 % (Part L2A: 2013) improvement in terms of building emission rate (BER) over the baseline scheme (TER) and then a predicted area weighted improvement of 3.07 % (Part L2A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Part L2A:2013
Without unregulated uses	58.67
With unregulated uses	79.06

4.03.04 Landlords Common Areas

The Building Regulations thermal model analysis identifies the following CO_2 emissions for the landlords common areas only incorporating energy efficiency measures:

	Part L2A:2013	
	Baseline Scheme (kg CO_2/m^2/year)	Lean Scheme (kg CO_2/m^2/year)
Heating	0.68	0.55
Cooling	0.00	0.00
Fans and pumps	0.62	0.73
Lighting	8.46	4.61
Domestic Hot Water	0.00	0.00
Part L2A :2013 Total	**9.79**	**5.89**
Unregulated Power	13.00	13.00
Total	**22.76**	**18.89**

The comparison of the energy efficient scheme against the baseline scheme identifies that for the landlords common parts there is a predicted 39.66% (Part L2A 2013) improvement in terms of building emission rate (BER) over the baseline scheme (TER) and then a predicted improvement of 17.01% (Part L2A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Lean Part L2A:2013
Without unregulated uses	50.89
With unregulated uses	163.22

4.03.05 Whole Development

The Building Regulations thermal model analysis identifies the following area weighted CO_2 emissions for the overall development:

	Part L:2013	
	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**
Part L Total	**14.57**	**11.60**
Unregulated Power	15.89	15.89
Total	**30.46**	**27.49**

The comparison of the energy efficient scheme against the baseline scheme identifies that for the proposed development there is a predicted 20.37% improvement in terms of carbon emission rate over the baseline scheme and then a predicted improvement of 9.75% when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the passive/low energy scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)	
	Baseline Part L:2013	**Lean Part L:2013**
Without unregulated uses	286.28	227.97
With unregulated uses	598.36	540.05

5.00 DECENTRALISED HEATING, COOLING AND POWER ASSESSMENT

5.01 General

The potential use of decentralised heating, cooling and power for the development has been assessed in relation to the following:

- Decentralised heating
- Decentralised cooling
- Combined heat and power (CHP)
- Combined cooling heat and power (CCHP/trigeneration)

5.02 Decentralised Heating and Cooling

Decentralised heating and cooling relates to a central system that provides the necessary heating and cooling water to more than one use or part of a building or to more than one building. For example a decentralised heating system can comprise central boiler plant that provides heat to separate dwellings and similarly a decentralised cooling system can comprise central refrigeration plant that provides cooling to individual retail units in a shopping centre.

Two types of decentralised heating and cooling schemes have been considered for the development.

1. Connection to a district energy network (DEN)
2. The provision of a development decentralised energy centre

District Energy Network

Investigations into existing or proposed district energy networks to provide decentralised heating and/or cooling to the development has established that there are no such current infrastructure arrangements within a reasonable distance from the development site. See below extract from the London Heat Map:



For the reasons described above a DEN is not a viable option for the development site however connections will be provided for future connectivity within the scheme.

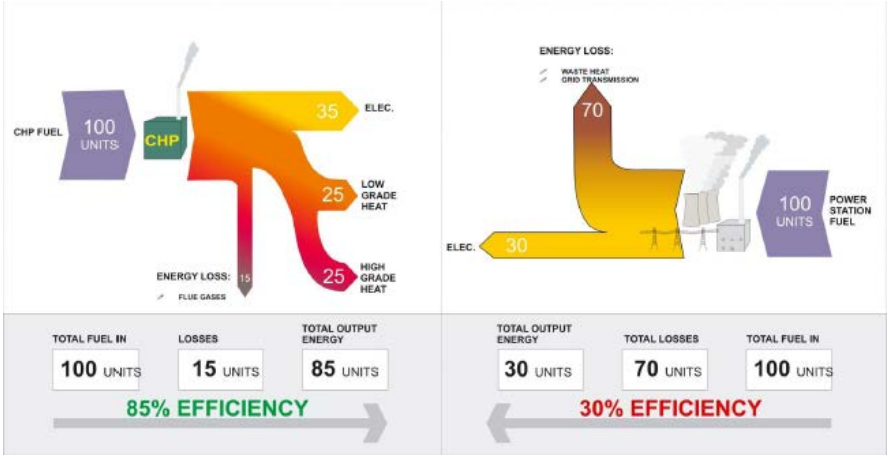
Decentralised Energy Centre

The development will be provided with central plant serving the building's apartments and landlords areas.

The retail unit will be provided with heating and cooling as fitted out by the incoming tenant.

5.03 Combined Heat and Power

Combined Heat and Power (CHP) generates electricity on site and recovers a proportion of the waste heat for use in heating and/or hot water generation for the building. This allows the overall efficiency to be significantly greater than the electricity generated via power stations feeding the National Grid. The CHP plant typically uses gas as the primary energy source and often incorporates a thermal store. Biomass fuelled CHP is possible however this is typically only for very large schemes due to operational difficulties with smaller capacity units.



Residential developments typically suit the required criteria justifying the use of a CHP. This is as a result of high sustained hot water demand from the apartments throughout the year along with heating demand in the winter months.

The electricity produced by the CHP unit would be used to provide power to the landlords common areas, plant and ancillary fans, amenity spaces and the heating and cooling plant which serve the retail unit.

CHP systems are typically considered only to be viable where they are able to run for at least 5000 hours per annum and have an appropriate year round heating demand.

The "Energy Planning – GLA Guidance on preparing energy assessments: (March 2016)" document stipulates that for a small/medium residential development of less than 500 apartments generally it is not economic to install CHP due to the small landlords electricity demand. This development is below the threshold stipulated above with only 144 apartments however a CHP is considered suitable as the CHP generated electricity will serve the landlords areas such as the two level basement car park lighting and ventilation as well as the apartments common areas across the development.

For the reasons detailed above CHP plant is considered a viable solution to meet the clean criteria.

5.04 Combined Cooling, Heat and Power

Combined Cooling, Heat and Power (CCHP) that is often referred to as trigeneration uses the same principles as detailed above for a CHP system however the heat produced is also used to generate cooling via an absorption chiller. The CCHP plant can make use of heat generated by the CHP plant in buildings with a cooling demand.



Similar to CHP plant the CCHP system is typically considered only to be viable where they are able to run for at least 5,000 hours per year and have an appropriate year round usage for the heat generated from the CCHP plant.

The residential and landlord common parts of this development does not benefit from comfort cooling and so there is no point in installing the cooling element of the CCHP. For this reason and reasons stipulated in section 5.03 CCHP is not considered viable for the development.

5.05 Decentralised Heating, Cooling and Power Analysis

5.05.01 Residential Apartments

The Building Regulations SAP calculations identify the following CO_2 emissions for the residential apartments incorporating the energy efficiency measures:

	CO_2 Emission (kg CO_2/ m^2/year)		
	Area Weighted Total		
	Baseline	**Lean**	**Clean**
Part L1A:2013 DER	**14.92**	**12.55**	**11.37**
Unregulated Uses	19.01	19.01	19.01
Total	**33.93**	**31.56**	**30.38**

For a full list of the clean emissions from each selected apartment type please refer to Appendix 1 of this document.

The comparison of the clean scheme against the baseline scheme identifies that for the residential areas there is a predicted 23.79% (Part L1A: 2013) improvement in terms of dwelling emission rate (DER) over the baseline scheme (TER) and then a predicted improvement of 10.46% (Part L1A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the clean scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Clean Part L1A:2013
Without unregulated uses	107.28
With unregulated uses	286.64

5.05.02 Landlords Common Areas

The Building Regulations thermal model analysis identifies the following CO_2 emissions for the landlords common areas only:

	Part L2A:2013		
	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**	**Clean Scheme (kg CO_2/m^2/year)**
Heating	0.68	0.55	0.85
Cooling	0.00	0.00	0.00
Fans and pumps	0.62	0.73	0.73
Lighting	8.46	4.61	4.61
Domestic Hot Water	0.00	0.00	0.00
Displaced Electricity	0.00	0.00	-0.56
Part L2A :2013 Total	**9.76**	**5.89**	**5.63**
Unregulated Power	13.00	13.00	13.00
Total	**22.76**	**18.89**	**18.63**

The comparison of the clean scheme against the baseline scheme identifies that for the landlords common parts there is a predicted 42.30% (Part L2A 2013) improvement in terms of building emission rate (BER) over the baseline scheme (TER) and then a predicted improvement of 18.14 % (Part L2A:2013) when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the clean scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)
	Clean Part L2A:2013
Without unregulated uses	48.66
With unregulated uses	160.99

5.05.03 Whole Development

The Building Regulations thermal model analysis identifies the following area weighted CO_2 emissions for the overall development:

	Part L:2013		
	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**	**Clean Scheme (kg CO_2/m^2/year)**
Part L Total	**14.57**	**11.60**	**10.92**
Unregulated Power	15.89	15.89	15.89

	Part L:2013		
	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**	**Clean Scheme (kg CO_2/m^2/year)**
Total	**30.46**	**27.49**	**26.81**

The comparison of the clean scheme against the baseline scheme identifies that for the proposed development there is a predicted 25.04% improvement in terms of carbon emission rate over the baseline scheme and then a predicted improvement of 11.98% when allowance is made for the unregulated uses.

The annual CO_2 emissions resulting from the clean scheme equates to the following:

	CO_2 Emission (tonnes CO_2/year)		
	Baseline Part L:2013	**Lean Part L:2013**	**Clean Part L:2013**
Without unregulated uses	286.28	227.97	214.60
With unregulated uses	598.36	540.05	526.69

6.00 RENEWABLE ENERGY ASSESSMENT

6.01 General

The potential use of renewable energy technology has been undertaken for the following:

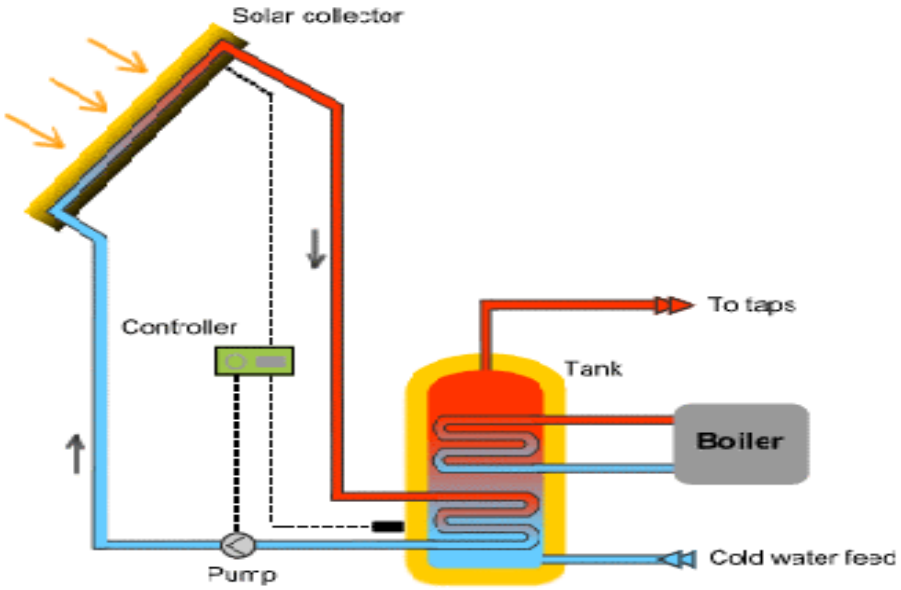
- Solar water heating
- Wind turbines
- Photovoltaic cells
- Biomass
- Ground source heating and cooling
- Air source heating and cooling
- Fuel cell

6.02 Solar Water Heating

Solar thermal panels utilise the suns energy to generate hot water for use within the building. The panels are commonly provided in either flat plate or evacuated tube arrangements. The panels are ideally located facing south at an approximate 30° inclination angle in areas where they are not subjected to shade.



The development has the potential to use solar water heating to pre-heat the domestic hot water service however the available roof space will be allocated to PV panels. Note a greater carbon saving will be achieved through using the available roof space for PV panels.



Due to the reasons stated previously solar hot water heating is not considered viable for the development.

6.03 Wind Turbines

Wind turbines generate electrical energy derived from kinetic energy provided by the local wind resource. The performance of wind turbines depends greatly on the wind speed and turbulence that in turn is influenced by the terrain and installation height.





In urban areas non-laminar wind flow occurs as a result of turbulence due primarily to adjacent buildings. There is growing evidence of urban wind turbines failing to perform in line with manufacturer's estimated outputs and as a result wind turbines are likely to produce only modest power outputs with corresponding low carbon dioxide emission reduction within urban sites.

For the reasons detailed above wind turbines are not considered viable for the development.

6.04 Photovoltaic Cells

Photovoltaic (PV) panels utilise the sun's energy to generate electricity. The optimum location for PV panels is south facing at an approximate 30° inclination angle in areas where they are not subjected to shade.





The development has unshaded roof areas that are not used as a building amenity and hence could be utilised for PV panels. Based on the various constraints imposed at roof level it has been assessed that an area of 216 m² can be provided over the roof area of the building which results in the following CO_2 reductions:

PV panel area	216 m^2
Approximate peak electrical output	43.8 kWp
Predicted annual carbon emission reduction for the apartments over the clean scheme	1.75 $kgCO_2/m^2$
	16.5 Tonnes CO_2/year
Offset of the green scheme CO_2 emissions for the apartments over the clean scheme	15.39 %

The PV panel area is based on 1.5m^2 of PV per apartment which can reasonably be used by the landlords system without giving the power produced back to the grid.

This PV panel area is the maximum that can be provided for the scheme and the PV panels will provide power benefitting the apartments and landlord areas. The below image shows the proposed potential location of PV panels at roof level:



6.05 Biomass

Biomass is considered to be a renewable fuel source as the CO_2 absorbed during the growth period is assessed as being approximately equal to the CO_2 emitted during combustion and hence deemed "carbon neutral". Biomass for boilers is typically wood either in chip or pellet form.

Biomass boilers require fuel storage together with associated transportation and delivery to the store location. Biomass boilers also increase the NOx emissions when compared to gas fired boilers.



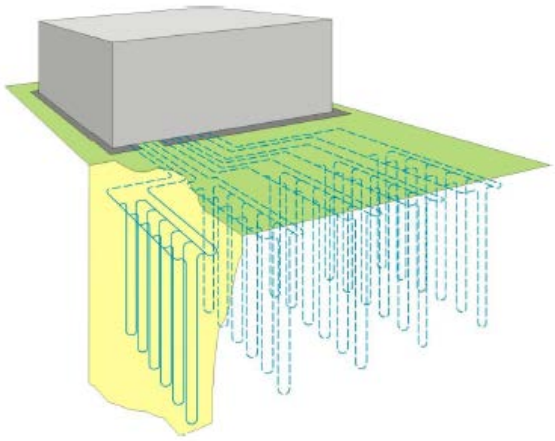


For this development there is no realistic space within the overall development for fuel storage together with the site constraints related to the associated delivery requirements. In addition there are on-going concerns with regard to the potential impact on local air quality.

For the reasons defined above the use of biomass is not considered viable for the development.

6.06 Ground Source Heating and Cooling

Ground source heating and cooling systems utilises the principle during heating mode of upgrading heat from the ground to a usable temperature and during cooling mode of rejecting heat from the building into the ground. There are two primary methods utilising either open or closed loop systems.



The open loop system extracts water, typically from the chalk aquifer, and uses this water in either the heating or cooling process before rejecting this heat back to the aquifer in a separate borehole. The open loop system requires licence approval from the Environment Agency that typically has a 10 year duration.

The closed loop system dissipates heat to or extracts heat from the ground via pipework circuits that are typically inserted into vertical boreholes. These generally do not require Environment Agency licences as no extraction of water from the aquifer takes place.

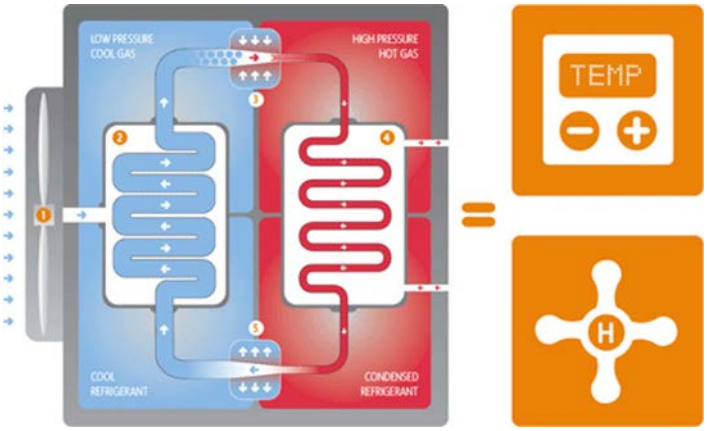
Generally for both the open and closed loop options heat pumps are used in order to generate the heating and cooling water temperatures needed within a building.

The potential use of a ground source heating and cooling system has been considered but ultimately rejected owing to the size of the scheme and economic viability of the installation of a ground source heat pump. For the increased capital cost a relatively small increase in carbon saving would be achieved. There is also no cooling provided which could result in a negative heat island effect in the local vicinity.

For these reasons a ground source heat pump system is not considered suitable for this development.

6.07 Air Source Heating and Cooling

Air sourced heat pump (ASHP) works on the same principles as a ground source heat pump (GSHP) however the medium in which heat is extracted is the external air rather than the ground. The ASHP can be reversed to provide cooling when required. ASHP will generally have a lower seasonal coefficient of performance when compared to GSHP.



Air source heat pumps are potentially suitable for use in the retail unit as it will have a separate heating and cooling solution to the rest of the building. They are not suitable for use in the apartments as the apartments do not have comfort cooling.

6.08 Fuel Cell

The fuel cell technology essentially converts chemical energy into both electrical and heat energy. The cell needs to be continually supplied with hydrogen (derived from either a piped or storage source) and oxygen (derived from air) which are combined and the chemical reaction produces electrical energy, heat energy and water vapour.

The fuel cell requires a hydrogen fuel source that can either be from a piped source (not currently available) or from stored gas. However the more usual approach currently in the UK is to use natural gas in order to generate the hydrogen required to operate the fuel cell.

Fuel cells have various commercial and technical limitations. There is a high initial capital cost together with there being few established suppliers and a very limited specialist design, installation and maintenance capabilities. Certain fuel cell elements require regular

replacement imposing a significant on-going cost implication. The fuel cells themselves are generally large, heavy and require fresh air ventilation.

Due to the initial capital cost, space requirements and on-going maintenance costs fuel cells are not considered viable for this development.

6.09 Energy Demand Impact

6.09.01 Viable Low and Zero Carbon Systems (LZC)

The proposed renewable energy sources for the whole development are:

Photovoltaic panels	-	216 m^2 of PV panels to provide a contribution to the electricity demand.
Air source heat pump	-	Air source heat pump will meet the heating and cooling load in the retail unit. This is already accounted for within the lean scheme due to assessing the retail unit on a shell only basis.

6.09.02 Residential Apartments

The SAP calculation have been repeated incorporating the PV panels to the apartments and the results are:

	CO_2 Emission (kg CO_2/ m^2/year)			
	Area Weighted Total			
	Baseline	Lean	Clean	Green
Part L1A:2013 DER	**14.92**	**12.55**	**11.37**	**9.62**
Unregulated Uses	19.01	19.01	19.01	19.01
Total	**33.93**	**31.56**	**29.22**	**28.63**

The improvement with renewable energy technologies over the lean scheme is 15.39% and the improvement incorporating renewable technologies over the baseline scheme is 35.52%.

The improvement with renewable energy technologies over the clean scheme when un-regulated energy uses are incorporated is 5.76% and the improvement with renewable technologies over the baseline scheme is 15.62% when unregulated uses are incorporated.

The annual CO_2 emissions resulting from the green scheme with renewable energy technologies equates to 90.76 tonnes without un-regulated uses and then 270.12 tonnes when un-regulated uses are taken into account.

6.09.03 Whole Development

The area weighted results for the development incorporating the renewable energy technologies are as follows:

	Baseline Scheme (kg CO_2/m^2/year)	**Lean Scheme (kg CO_2/m^2/year)**	**Clean Scheme (kg CO_2/m^2/year)**	**Green Scheme (kg CO_2/m^2/year)**
Part L2A : 2013 Total	**14.57**	**11.60**	**10.92**	**10.08**
Unregulated Power	15.89	15.89	15.89	15.89
Total	**30.46**	**27.49**	**26.81**	**25.97**

The annual CO_2 emissions for the overall development incorporating renewable energy technologies are 10.08kg CO_2/m^2.

The improvement with renewable energy technologies over the clean scheme is 7.69% and the improvement with renewable technologies over the baseline scheme is 31.81%.

The annual CO_2 emissions for the overall development allowing for un-regulated energy uses with the renewable energy technologies are 25.97kg CO_2/m^2.

The improvement with renewable energy technologies when unregulated energy uses are incorporated over the lean scheme is 3.13% and the improvement with renewable technologies over the baseline scheme is 14.74%.

	CO_2 Emission (tonnes CO_2/year)			
	Baseline Part L:2013	**Lean Part L:2013**	**Clean Part L:2013**	**Green Part L:2013**
Without unregulated uses	286.28	227.97	214.60	198.09
With unregulated uses	598.36	540.05	526.69	510.18

7.00 APARTMENT OVERHEATING ANALYSIS ASSESSMENT

7.01 Background

As part of the GLA's Planning Policy 5.9 developers are encouraged to reduce the risk of overheating and assist in negating the need for cooling in all new developments.

CIBSE TM52: 2013 as referred to in the "Energy Planning – GLA Guidance on preparing energy assessments: (March 2016)" sets out three criteria which should be met in order to assess whether there is an excessive risk of overheating. The criteria are as follows:

Criterion 1: Hours of Exceedance:
This criteria sets a limit on the number of hours that operative temperature can exceed the threshold comfort temperature by 1K or more for a maximum of 3% occupied hours. The number of acceptable hours within a living room is 32 and in a bedroom is 50.

Criterion 2: Daily Weighted Exceedance:
This criteria assesses the severity of overheating in any one day and sets a limit of acceptability.

Criterion 3: Upper Limit Temperature:
This criteria sets the absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

As defined in TM52 provided each apartment passes at least two of the three above criteria it can be deduced there is a low risk of overheating.

Given that Criteria 2 and 3 are essentially based on Criteria 1 arguably Criteria 1 is the most important Criteria to pass. This is owing to the fact that if the other two criteria are failed and Criteria 1 passed, then the overheating will be restricted to a short period of time (maximum of 32 or 50 hours depending on the room use).

Each apartment type has been assessed using dynamic thermal modelling software (EDSL TAS) and a pass or fail is given for each type. The analysis follows the iterative process undertaken to reduce the overheating risk. The overheating analysis has been completed for each of the three TM49 design summer years (DSY's) as required by the GLA Energy Planning document.

Where fabric thermal improvements have been necessary to meet more stringent energy and carbon emission requirements heat cannot naturally dissipate from buildings to the same extent as previously during the summer months. This has resulted (particularly in apartment buildings) in there being increased risk of overheating which is why the GLA requirements and TM52 exist.

It is noted that based on previous experience the overheating models (particularly in the London Heathrow DSY files used for this assessment) are difficult to pass using the criteria set out in TM52. The climate change years in particular (1976 and 2003) often find that living rooms fail to pass the required criteria as this reflects a high standard to be aspired to within the GLA guidance.

The requirements and criteria set out by TM52 are designed to be very challenging and this is to encourage developers to do all that they can to mitigate the overheating risk.

CIBSE Guide A stipulates that people are less sensitive to temperature fluctuations when they are in their own home. However it also states that more attention should be given to the bedrooms as thermal comfort studies have shown that the quality of sleep deteriorates at higher internal temperatures. Therefore reasonable internal temperatures within bedrooms

are arguably more important to achieve as this will directly affect the health and well-being of the occupant.

7.02 Apartment Overheating Analysis Assessment

This analysis follows the building form set out in the planning drawings and the fabric criteria set out in this report. The primary measures which were undertaken to reduce overheating are as follows:

- High density exposed thermal mass to the building façade
- Openable area of the windows
- G-value of the glazing

The analysis which follows has been completed on sample apartment types throughout the development (note that floors one to three are identical and as such only the apartments on the third floor have been analysed). The apartments are predominantly South facing apartments which are considered to be the 'worst case' apartment types.

The below mark-up shows the location and reference of each apartment assessed:

Level 3:



Level 5:



Level 6:



The overheating analysis has been completed in compliance with the requirements of the GLA Policy 5.9 which includes the incorporation of three Design Summer Year weather files

from 1976, 1989 and 2003. The results in the assessment have taken account of the London Heathrow DSY weather files which are most applicable to this site.

The thermal properties listed earlier in this report have been used throughout the assessment. The window G-value of 0.50 has not been exceeded owing to its negative impact on the carbon emissions and statutory fabric energy efficiency element of the assessment.

7.02.01 Analysis

The results from each DSY are noted below. The results shown refer to the number of aforementioned overheating criteria achieved. Note, that if the apartment is of the studio type a value will be given under the 'living room' column only.

London Heathrow 1976 DSY

	LHR 1976 DSY			
	Living Room	Bed 1	Bed 2	Bed 3
Flat 1	0/3	3/3	N/A	N/A
Flat 2	0/3	3/3	3/3	N/A
Flat 3	0/3	N/A	N/A	N/A
Flat 4	0/3	3/3	3/3	N/A
Flat 5	0/3	3/3	N/A	N/A
Flat 6	0/3	3/3	3/3	3/3
Flat 7	0/3	3/3	3/3	N/A
Flat 8	1/3	3/3	3/3	N/A
Flat 9	0/3	3/3	3/3	N/A
Flat 10	1/3	3/3	3/3	N/A
Flat 11	0/3	3/3	3/3	N/A
Flat 12	0/3	3/3	2/3	N/A

The living rooms in this scenario do not pass all of the required criteria to mitigate overheating. The number of acceptable hours of exceedance for Criteria 1 for a living room is 32 that equates to 3.0% of the summer occupied hours and the average exceedance of these apartments is 78 which is 7.3% of the summer occupied hours.

London Heathrow 1989 DSY

	LHR 1989 DSY			
	Living Room	Bed 1	Bed 2	Bed 3
Flat 1	0/3	3/3	N/A	N/A
Flat 2	0/3	3/3	3/3	N/A
Flat 3	1/3	3/3	3/3	N/A
Flat 4	0/3	3/3	3/3	N/A
Flat 5	0/3	3/3	N/A	N/A
Flat 6	0/3	3/3	3/3	3/3
Flat 7	0/3	3/3	3/3	N/A
Flat 8	1/3	3/3	3/3	N/A
Flat 9	0/3	3/3	3/3	N/A
Flat 10	0/3	3/3	3/3	N/A
Flat 11	0/3	3/3	3/3	N/A
Flat 12	1/3	3/3	3/3	N/A

The average number of hours of exceedance in the living rooms for this weather file is 55 which is 5.1% of the summer occupied hours.

London Heathrow 2003 DSY

	LWC 2003 DSY			
	Living Room	Bed 1	Bed 2	Bed 3
Flat 1	1/3	3/3	N/A	N/A
Flat 2	0/3	3/3	3/3	N/A
Flat 3	1/3	3/3	3/3	N/A
Flat 4	0/3	N/A	N/A	N/A
Flat 5	0/3	3/3	3/3	N/A
Flat 6	0/3	3/3	3/3	3/3
Flat 7	0/3	3/3	3/3	N/A
Flat 8	0/3	3/3	3/3	N/A
Flat 9	0/3	3/3	3/3	N/A
Flat 10	0/3	3/3	3/3	N/A
Flat 11	0/3	3/3	3/3	N/A
Flat 12	0/3	3/3	3/3	N/A

The average number of hours of exceedance in the living rooms for this weather file is 55 which is 5.1% of the summer occupied hours.

7.03 Conclusions

The bedrooms throughout all of the assessed apartment pass all three overheating criteria using the three London Heathrow DSYs.

For the 2003 climate change weather file, which in this analysis leads to the worst case results, all three of the overheating criteria are not passed in four instances and only a single living area passes the overheating assessment. Despite this, the percentage of summer occupied hours by which they exceed the allowable limit defined by Criteria 1 is a maximum of 3.7% when taken as an average. The development passes Criteria 1 on average in the 1989 and 2003 DSYs and although the remaining two overheating criteria may not be satisfied, this limits the extent to which the apartments are able to overheat.

The above results show that the apartments assessed meet the overheating criteria in all of the bedrooms which are the principal concern related to occupant health and well-being. Although the living rooms do not pass the criteria required for all weather files when the numbers are looked at as an average the figures are still very low percentages plus the spaces have fully openable windows to maximise the natural ventilation provision.

In order to further improve the building's performance and reduce the overheating risk there will likely be a detrimental effect on the agreed building form in addition to there being a negative effect on the carbon emissions of each building. The most logical further step to improve the overheating performance would be to reduce the G-value but this will increase the carbon emissions of the development (owing to additional heating being required in the winter) and have a detrimental effect on the Fabric Energy Efficiency (FEE) required to pass statutory Building Regulations.

8.00 RETAIL UNIT OVERHEATING ANALYSIS ASSESSMENT

8.01 General

The "Testing for the presence or likelihood of overheating" criteria as set out in TM52 and the subsequent 2015 edition the CIBSE Guide A means that the overheating analysis is undertaken in two separate stages:

Stage	Operating Mode	Overheating Analysis Assessment Method
1	Free running i.e. no mechanical comfort cooling provided	Indoor operative temperature
2	Mechanical comfort cooling	Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD)

8.02 Software Utilised

The overheating analysis work has been undertaken using EDSL TAS dynamic simulation software version 9.4.3.

8.03 Overheating Risk Criteria

8.03.01 Free Running Building

The TM52 overheating compliance criteria for a free running building to be regarded as not overheating is that two of the three criteria set out below need to be met.

The pass / fail limits for the three criteria are summarised below:

Criterion 1	Hours of Exceedance (H_e)	The first criterion sets a limit of 3% for the number of occupied hours that the operative temperature (T_{op}) can exceed T_{max} during a typical non-heating season. T_{max} being exceeded is indicated by $\Delta T > 1K$
Criterion 2	Daily Weighted Exceedance (W_e)	The second criterion deals with the severity of overheating within any one day, which is given in terms of temperature rise and duration and sets a daily limit for acceptability. This is indicated by the weighted exceedance being less than or equal to 6
Criterion 3	Upper Limit Temperature (T_{upp})	The third criterion sets an absolute maximum acceptable temperature for a room. This is indicated by ΔT shall not exceeding 4 K.

The terminology in the above table is defined as:

Operative temperature (T_{op})	The resultant hourly room air temperature calculated by the dynamic simulation software
Maximum acceptable temperature (T_{max})	T_{max} is calculated for each day from the running mean of the outdoor temperature. In accordance with Category II in BS EN 15251 T_{max} has been set at a maximum acceptable temperature of 3K above the comfort temperature.
Non-heating season	1st May to 30th September
Delta T (ΔT)	This is a simple equation where $\Delta T = T_{op} - T_{max}$

8.03.02 Mechanically Comfort Cooled Building

The TM52 overheating compliance criteria for a mechanically cooled building are as set out below in the extract from TM52.

"A mechanically cooled building should aim to provide an indoor environment where the PMV index is near to or equal to zero. According to Table 2, it will be considered as overheating if the value of the PMV index is above 0.5 (PPD ≥ 10%)."

However this criterion has been further refined in the 2015 edition of the CIBSE Guide A. The applicable extract from the 2015 CIBSE Guide A is as follows:

"A mechanically cooled building should aim to provide an indoor environment where the PMV index is near to or equal to zero. It will be considered as overheating if the value of the PMV index is above 0.5 (equivalent to a PPD of 10%).

The predicted indoor temperature or values of PMV should not exceed the tabulated values for more than 3% of occupied hours."

For heated and mechanically cooled buildings, the PMV (Predicted Mean Vote) is an index that predicts the mean votes of a large group of people on the seven-point thermal sensation scale (below) based on the heating balance of the human body. Thermal balance is obtained when the internal heat production in the body is equal to the loss of heat to the environment.

PPD (predicted percentage dissatisfied) is an index that establishes a quantitative prediction of the percentage of thermally dissatisfied people who feel too cool or too warm. For the purposes of ISO 7730, thermally dissatisfied people are those who will feel hot, warm, cool or cold.

Seven Point Thermal Sensation Scale	
3	Hot
2	Warm
1	Slightly warm
0	Neutral
-1	Slightly cool
-2	Cool
-3	Cold

Based on the ISO 7730 if you fall between 1 and -1 of the thermal sensation scale the occupants of the building are thermally satisfied.

The PPD results include dissatisfied people who are “slightly cool”, “cool” or “cold”. From an overheating perspective the occupants whose perception is that they are too cool needs to be discounted when applying the above compliance criteria.

8.04 Retail Unit

8.04.01 General

In accordance with tenants expectations the retail unit accommodation is proposed to be mechanically comfort cooled. Therefore the risk of overheating during occupied hours in these areas is minimised due to the provision of the comfort cooling.

This overheating risk analysis has been undertaken in two parts. Firstly the initial risk analysis has been run without comfort cooling and secondly a comfort cooled analysis has been simulated.

As with all mechanically comfort cooled buildings a slight risk of overheating still does exist if the prevailing ambient conditions are in excess of the design criteria external temperatures.

The applicable accommodation use/designation National Calculation Method (NCM) internal heat gains have been used in this Overheating Risk Analysis.

8.04.02 Free Running Analysis

The free running analysis has been dynamically simulated and the subsequent associated results calculated for the retail unit accommodation for each of the three TM49 DSY’s in accordance with the recommendations of TM52. The results for each DSY are summarised in the following sub sections of this report.

Using the dynamic software the resultant room air temperature has been calculated for each occupied hour in each room / zone for each of the three TM49 design summer years.

In addition the running mean of the outdoor temperature (T_{rm}) has been calculated from the DSY weather data for the non-heating season, 1st May to 30th September and hence the limiting maximum acceptable temperature *(T_{max})* for the assessed rooms has been calculated.

8.04.02.01 Free Running Analysis

To be regarded as not at risk from overheating two of the three TM52 free running criteria must be met.

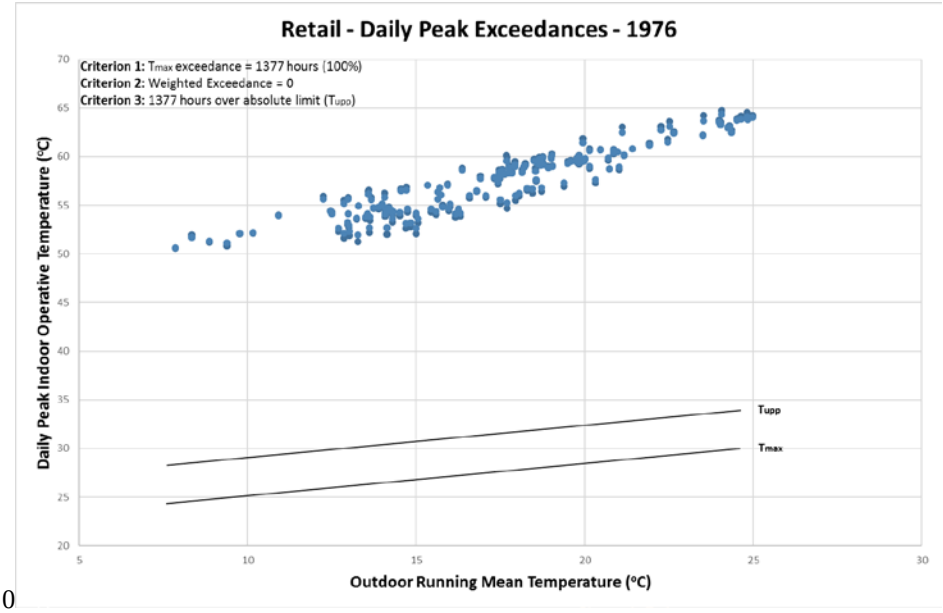
8.04.02.02 Retail Unit - Free Running Analysis - TM49 DSY: 1976 LWC

A summary of the dynamic simulation results is as follows:

TM49 DSY: 1976 LWC	
Criterion 1	ΔT > 1K during some occupied hours The calculated resultant percentage of occupied hours where ΔT > 1K is 100.00% The limiting value of percentage of occupied hours is 3% hence this criterion is failed.
Criterion 2	The worst case day for ΔT > 1K is day 180 The calculated W_e is 0.0 The limiting value of W_e is 6 hence this criterion is passed (see note below).
Criterion 3	ΔT exceeds 4K for a total of 1377 occupied hours during the assessed summer period.
Summary	One of the 3 criteria has passed The limiting criteria is a pass in 2 out of the 3 criteria Hence overheating is at risk of occurring.

Note: Note that in this case Criterion 2 has passed, however Criterion 2 is assessed by analysing the hours in which the operative temperature is between the T_{max} and T_{upp} limiting temperatures. As the T_{upp} limiting temperature is exceeded for 100.00 % of occupied hours the data available for assessing Criterion 2 is restricted, ultimately leading to a pass mark being achieved. This condition can only occur when both Criteria 1 and 2 have failed and therefore a false pass may never be achieved.

These results are shown graphically below:



0

Based on the recommendations of TM52 the retail unit development is shown to have a risk of overheating when operating in free running mode for the 1976 DSY.

Each zone has been shown to fail 2 of the 3 criteria and hence based on the recommendations of TM52 have a predicted risk of overheating during prolonged periods of high external ambient temperature when operating in free running mode for the 1976 DSY.

Therefore additional measures need to be employed to reduce the predicted risk of overheating. See section 8.06 of this report for further details.

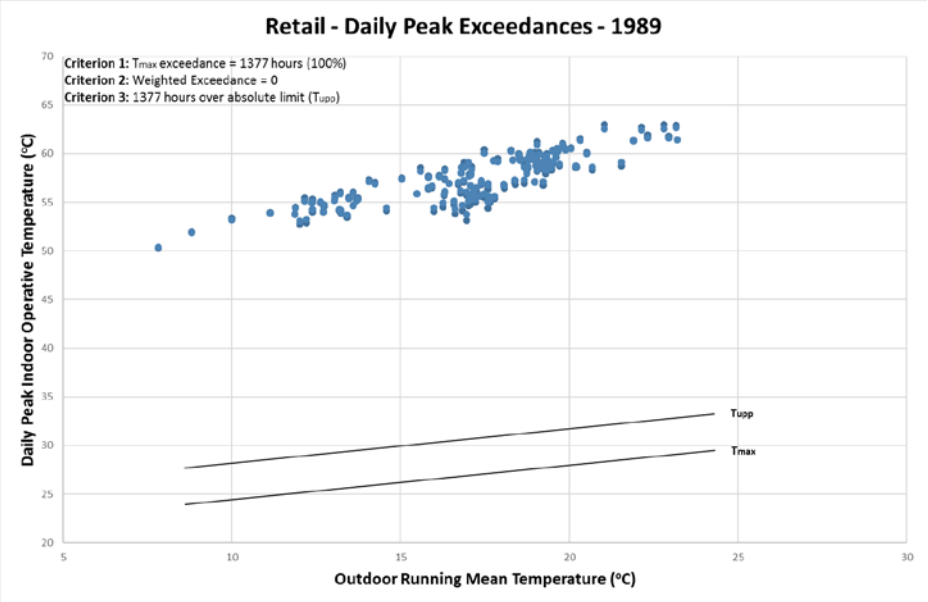
8.04.02.03 Retail Unit - Free Running Analysis - TM49 DSY: 1989 LWC

A summary of the dynamic simulation results is as follows:

TM49 DSY: 1989 LWC	
Criterion 1	ΔT > 1K during some occupied hours The calculated resultant percentage of occupied hours where ΔT > 1K is 100.00% The limiting value of percentage of occupied hours is 3% hence this criterion is failed.
Criterion 2	The worst case day for ΔT > 1K is day 204 The calculated W_e is 0.0 The limiting value of W_e is 6 hence this criterion is passed (see note below).
Criterion 3	ΔT exceeds 4K for a total of 1377 occupied hours during the assessed summer period.
Summary	One of the 3 criteria has passed. The limiting criteria is a pass in 2 out of the 3 criteria Hence overheating is at risk of occurring.

Note: Note that in this case Criterion 2 has passed, however Criterion 2 is assessed by analysing the hours in which the operative temperature is between the T_{max} and T_{upp} limiting temperatures. As the T_{upp} limiting temperature is exceeded for 100.00 % of occupied hours the data available for assessing Criterion 2 is restricted, ultimately leading to a pass mark being achieved. This condition can only occur when both Criteria 1 and 2 have failed and therefore a false pass may never be achieved.

These results are shown graphically below:



Based on the recommendations of TM52 the retail unit development is shown to have a risk of overheating when operating in free running mode for the 1989 DSY.

Each zone has been shown to fail 2 of the 3 criteria and hence based on the recommendations of TM52 have a predicted risk of overheating during a 'moderately warm summer' when operating in free running mode for the 1989 DSY.

Therefore additional measures need to be employed to reduce the predicted risk of overheating. See section 8.06 of this report for further details.

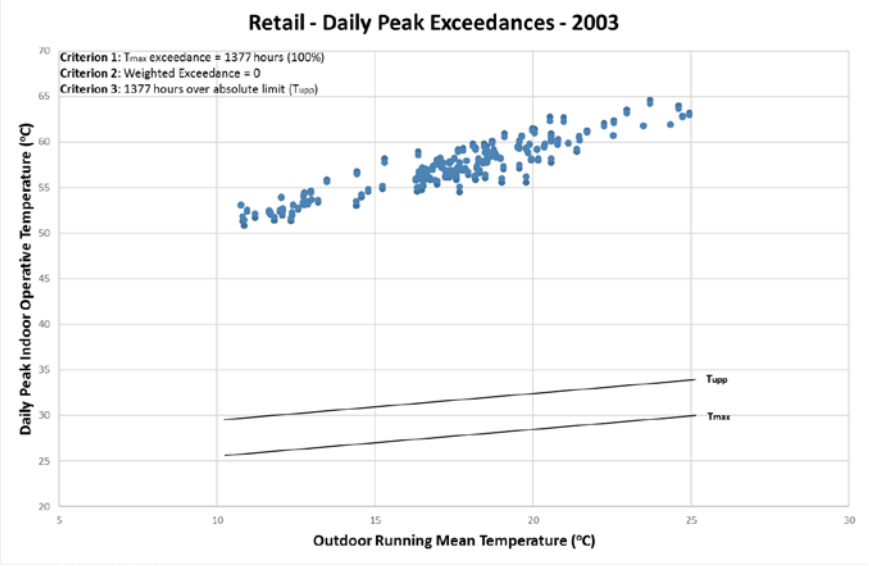
8.04.02.04 Retail Unit - Free Running Analysis - TM49 DSY: 2003 LWC

A summary of the dynamic simulation results is as follows:

TM49 DSY: 2003 LWC	
Criterion 1	ΔT > 1K during some occupied hours The calculated resultant percentage of occupied hours where ΔT > 1K is 100.00% The limiting value of percentage of occupied hours is 3% hence this criterion is failed.
Criterion 2	The worst case day for ΔT > 1K is day 222 The calculated W_e is 0.0 The limiting value of W_e is 6 hence this criterion is passed (see note below).
Criterion 3	ΔT exceeds 4K for a total of 2488 hours during the assessed summer period.
Summary	One of the 3 criteria has passed. The limiting criteria is a pass in 2 out of the 3 criteria Hence overheating is at risk of occurring.

Note: Note that in this case Criterion 2 has passed, however Criterion 2 is assessed by analysing the hours in which the operative temperature is between the T_{max} and T_{upp} limiting temperatures. As the T_{upp} limiting temperature is exceeded for 100.00 % of occupied hours the data available for assessing Criterion 2 is restricted, ultimately leading to a pass mark being achieved. This condition can only occur when both Criteria 1 and 2 have failed and therefore a false pass may never be achieved.

These results are shown graphically below:



Based on the recommendations of TM52 the retail unit development is shown to have a risk of overheating when operating in free running mode for the 2003 DSY.

Each zone has been shown to fail 2 of the 3 criteria and hence based on the recommendations of TM52 have a predicted risk of overheating during prolonged periods of high external ambient temperature when operating in free running mode for the 2003 DSY.

Therefore additional measures need to be employed to reduce the predicted risk of overheating. See section 8.06 of this report for further details.

8.05 Mechanical Comfort Cooling Analysis

Using the dynamic software the PMV and the PPD has been established for the retail unit area for each of the three TM49 design summer years.

In accordance with TM52 the building would be regarded as at risk from overheating the if the PMV index is above 5% for more than 3% of the occupied hours.

8.05.01 Retail Unit

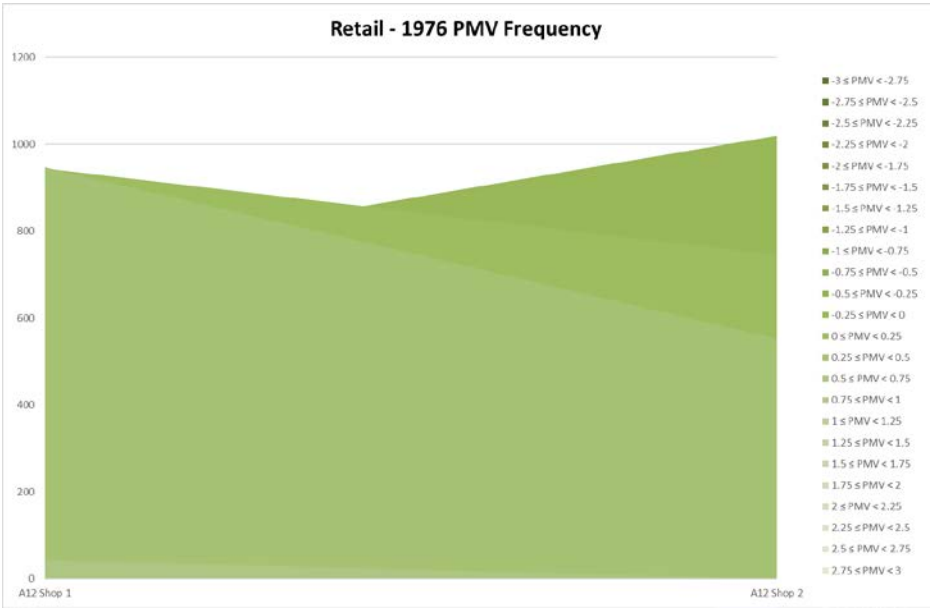
8.05.01.01 Mechanical Comfort Cooling Analysis – TM49 DSY: 1976 LWC

The table below shows the range of the thermal sensation scale and the average hours for the year which meets the criterion.

	-3 ≤ PMV < -2.75	-2.75 ≤ PMV < -2.5	-2.5 ≤ PMV < -2.25	-2.25 ≤ PMV < -2	-2 ≤ PMV < -1.75	-1.75 ≤ PMV < -1.5	-1.5 ≤ PMV < -1.25	-1.25 ≤ PMV < -1	-1 ≤ PMV < -0.75	-0.75 ≤ PMV < -0.5	-0.5 ≤ PMV < -0.25	-0.25 ≤ PMV < 0	0 ≤ PMV < 0.25	0.25 ≤ PMV < 0.5	0.5 ≤ PMV < 0.75	0.75 ≤ PMV < 1	1 ≤ PMV < 1.25	1.25≤ PMV < 1.5	1.5 ≤ PMV < 1.75	1.75 ≤ PMV < 2	2 ≤ PMV < 2.25	2.25 ≤ PMV < 2.5	2.5 ≤ PMV < 2.75	2.75 ≤ PMV ≤ 3
Average (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	794	875.5	844.5	749.5	21.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.7	26.7	25.7	22.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Based on the results from a thermal comfort perspective the 100.0% of occupied hours fall between -1.0 ≤ PMV < 1.0 frequency. Therefore based on the recommendations of ISO 7730 the occupants of the building are thermally satisfied.

This is graphically illustrated below.



The zones below the graph represent how the building has been split within the thermal model.

Applying the TM52 & CIBSE Guide A 2015 edition risk of overheating criteria to the results indicates that the building is not at risk of overheating as the percentage of occupied hours that have a PMV of greater than 0.5 is 2.2% and is therefore below the prescribed tolerance of 3% of when a building would be regarded as overheating.

The PPD analysis results are indicated below.

	0% ≤ *PPD < 10%*	***10% ≤*** *PPD < 20%*	***20% ≤*** *PPD < 30%*	***30% ≤*** *PPD < 40%*	***40% ≤*** *PPD < 50%*	***50% ≤*** *PPD < 60%*	***60% ≤*** *PPD < 70%*	***70% ≤*** *PPD < 80%*	***80% ≤*** *PPD < 90%*	***90% ≤ PPD ≤*** *100%*
Average (hr)	3263	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	99.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The results show that the retail accommodation has a percentage of PPD greater than 10% of 0.7%.

Therefore the mechanically comfort cooled building overheating risk analysis for the TM49 design summer year for 1976 at London Weather Centre indicates that the retail unit accommodation is not at risk of overheating.

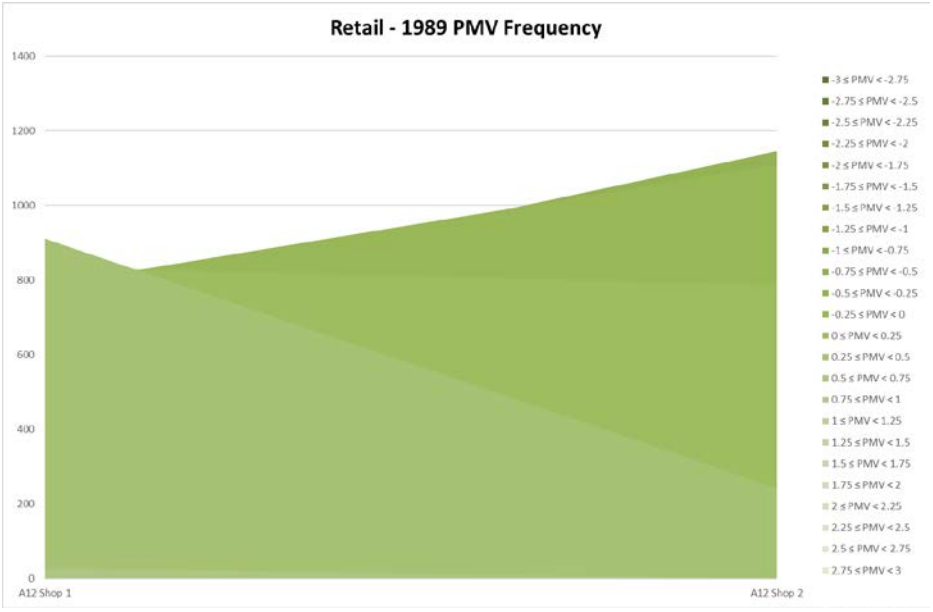
8.05.01.02 Mechanical Comfort Cooling Analysis – TM49 DSY: 1989 LWC

The table below shows the range of the thermal sensation scale and the average hours for the year which meets the criterion.

	-3 ≤ PMV < -2.75	**-2.75 ≤ PMV < -2.5**	**-2.5 ≤ PMV < -2.25**	-2.25 ≤ **PMV < -2**	**-2 ≤ PMV < -1.75**	**-1.75 ≤ PMV < -1.5**	**-1.5 ≤ PMV < -1.25**	**-1.25 ≤ PMV < -1**	**-1 ≤ PMV < -0.75**	**-0.75 ≤ PMV < -0.5**	**-0.5 ≤ PMV < -0.25**	**-0.25 ≤ PMV < 0**	**0 ≤ PMV < 0.25**	**0.25 ≤ PMV < 0.5**	**0.5 ≤ PMV < 0.75**	**0.75 ≤ PMV < 1**	**1 ≤ PMV < 1.25**	**1.25≤ PMV < 1.5**	**1.5 ≤** PMV < 1.75	**1.75 ≤ PMV < 2**	**2 ≤ PMV < 2.25**	**2.25 ≤ PMV < 2.5**	**2.5 ≤ PMV < 2.75**	**2.75 ≤ PMV ≤ 3**
Average (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	935	947.5	811	577	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.5	28.8	24.7	17.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Based on the results from a thermal comfort perspective the 100.0% of occupied hours fall between -1.0 ≤ PMV < 1.0 frequency. Therefore based on the recommendations of ISO 7730 the occupants of the building are thermally satisfied.

This is graphically illustrated below.



The zones below the graph represent how the building has been split within the thermal model.

Applying the TM52 & CIBSE Guide A 2015 issue risk of overheating criteria to the results indicates that the building is not at risk of overheating as the percentage of occupied hours that have a PMV of greater than 0.5 is 0.4% and is therefore below the prescribed tolerance of 3% of when a building would be regarded as overheating.

The PPD analysis results are indicated below.

	0% ≤ *PPD <* *10%*	***10% ≤*** *PPD <* *20%*	***20% ≤*** *PPD <* *30%*	***30% ≤*** *PPD <* *40%*	***40% ≤*** *PPD <* *50%*	***50% ≤*** *PPD <* *60%*	***60% ≤*** *PPD <* *70%*	***70% ≤*** *PPD <* *80%*	***80% ≤*** *PPD <* *90%*	***90% ≤*** ***PPD ≤*** *100%*
Average (hr)	3263	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	99.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The results show that the retail unit accommodation has a percentage of PPD greater than 10% of 0.7%.

Therefore the mechanically comfort cooled building overheating risk analysis for the TM49 design summer year for 1989 at London Weather Centre indicates that the retail unit accommodations is not at risk of overheating.

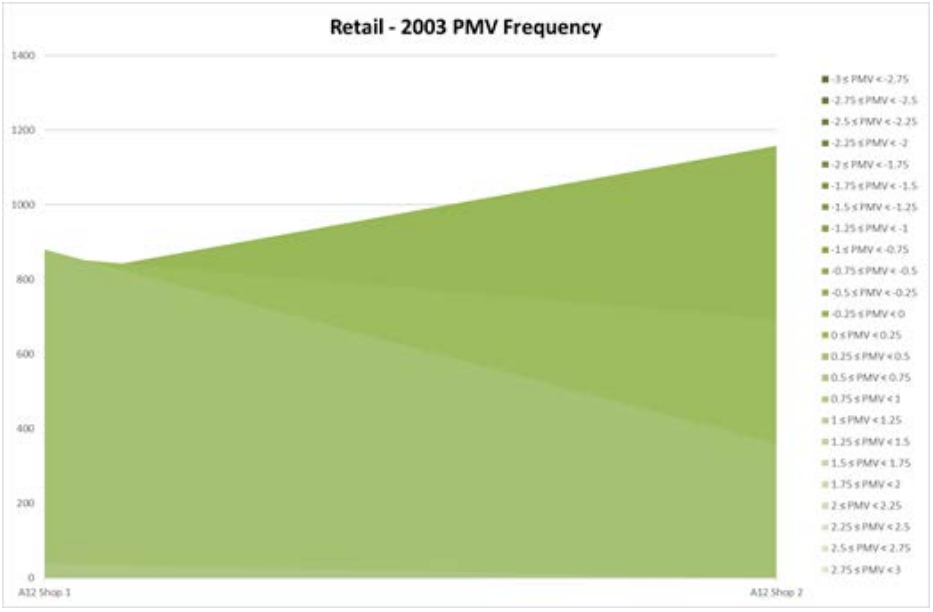
8.05.01.03 Mechanical Comfort Cooling Analysis – TM49 DSY: 2003 LWC

The table below shows the range of the thermal sensation scale and the average hours for the year which meets the criterion.

	-3 ≤ PMV < -2.75	**-2.75 ≤ PMV < -2.5**	**-2.5 ≤ PMV < -2.25**	**-2.25 ≤ PMV < -2**	**-2 ≤ PMV < -1.75**	**-1.75 ≤ PMV < -1.5**	**-1.5 ≤ PMV < -1.25**	**-1.25 ≤ PMV < -1**	**-1 ≤ PMV < -0.75**	**-0.75 ≤ PMV < -0.5**	**-0.5 ≤ PMV < -0.25**	**-0.25 ≤ PMV < 0**	**0 ≤ PMV < 0.25**	**0.25 ≤ PMV < 0.5**	**0.5 ≤ PMV < 0.75**	**0.75 ≤ PMV < 1**	**1 ≤ PMV < 1.25**	**1.25≤ PMV < 1.5**	**1.5 ≤ PMV < 1.75**	**1.75 ≤ PMV < 2**	**2 ≤ PMV < 2.25**	**2.25 ≤ PMV < 2.5**	**2.5 ≤ PMV** < 2.75	**2.75 ≤ PMV ≤ 3**
Average (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	886.5	981.5	777.5	620.5	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	29.9	23.7	18.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Based on the results from a thermal comfort perspective the 100.0% of occupied hours fall between -1.0 ≤ PMV < 1.0 frequency. Therefore based on the recommendations of ISO 7730 the occupants of the building are thermally satisfied.

This is graphically illustrated below.



The zones below the graph represent how the building has been split within the thermal model.

Applying the TM52 & CIBSE Guide A 2015 issue risk of overheating criteria to the results indicates that the building is not at risk of overheating as the percentage of occupied hours that have a PMV of greater than 0.5 is 0.6% and is therefore below the prescribed tolerance of 3% of when a building would be regarded as overheating.

The PPD analysis results are indicated below.

	0% ≤ *PPD <* *10%*	***10% ≤*** *PPD <* *20%*	***20% ≤*** *PPD <* *30%*	***30% ≤*** *PPD <* *40%*	***40% ≤*** *PPD <* *50%*	***50% ≤*** *PPD <* *60%*	***60% ≤*** *PPD <* *70%*	***70% ≤*** *PPD <* *80%*	***80% ≤*** *PPD <* *90%*	***90% ≤*** ***PPD ≤*** *100%*
Average (hr)	3264	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percentage (%)	99.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The results show that the retail unit accommodation has a percentage of PPD greater than 10% of 0.6%.

Therefore the mechanically comfort cooled building overheating risk analysis for the TM49 design summer year for 2003 at London Weather Centre indicates that the retail unit accommodation is not at risk of overheating.

8.06 Overheating / Thermal Comfort Strategy

The modelled scheme incorporates the following passive design features to reduce the risk of overheating:

- High performance glazing that has a 'U' value of 1.5 W/m^{2}K and a 'G' value of 0.40
- High efficiency LED lighting
- High thermal mass
- Good practice unregulated power loads

The proposed retail unit with passive design measures has been thermally modelled. The TM52 free running overheating results for each of the three TM49 design summer years indicate that each assessed zone has a risk of overheating due to failing two of the three TM52 criteria for each of the three TM49 design summer years.

Therefore, additional mechanical ventilation comfort cooling measures have been incorporated to alleviate the overheating risk. The additional measures are required to cater for the design weather data, the design internal heat gains plus the operational requirements / constraints of the future tenant.

The TM52 mechanical comfort cooling overheating risk analysis, the PMV and PPD results indicate that overheating in the comfort cooled retail unit accommodation is not a risk. Hence the proposed mechanical heat recovery ventilation systems and the mechanical comfort cooling systems are appropriate.

9.00 OVERALL DEVELOPMENT ANALYSIS

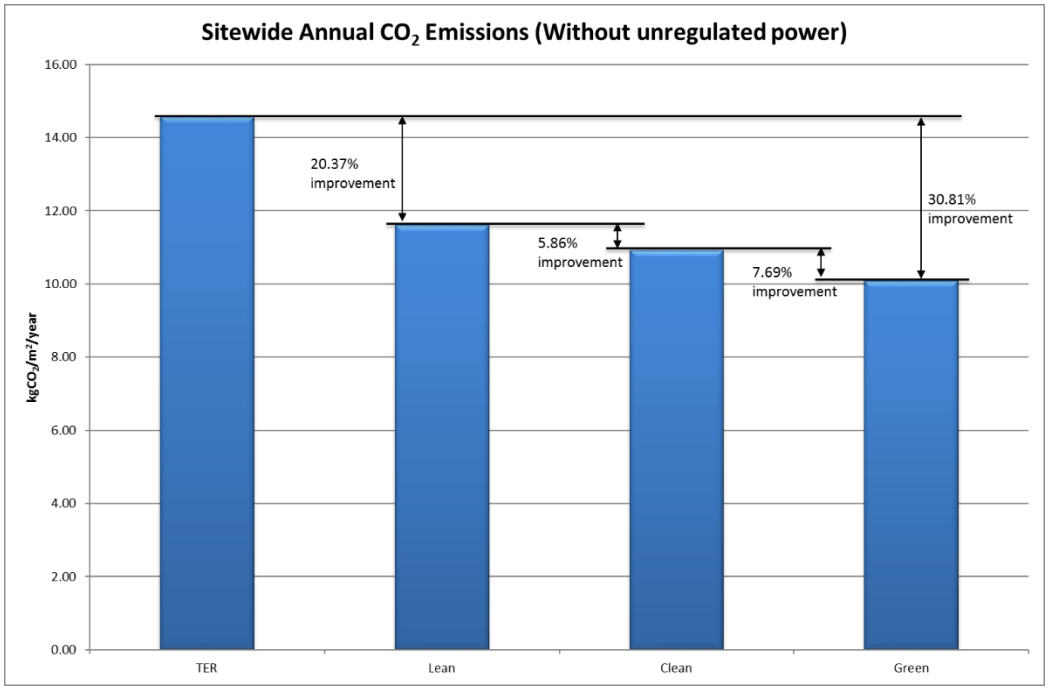
9.01 Carbon Reduction - Development Regulation 2013 Baseline

The overall development analysis can then be summarised as follows:

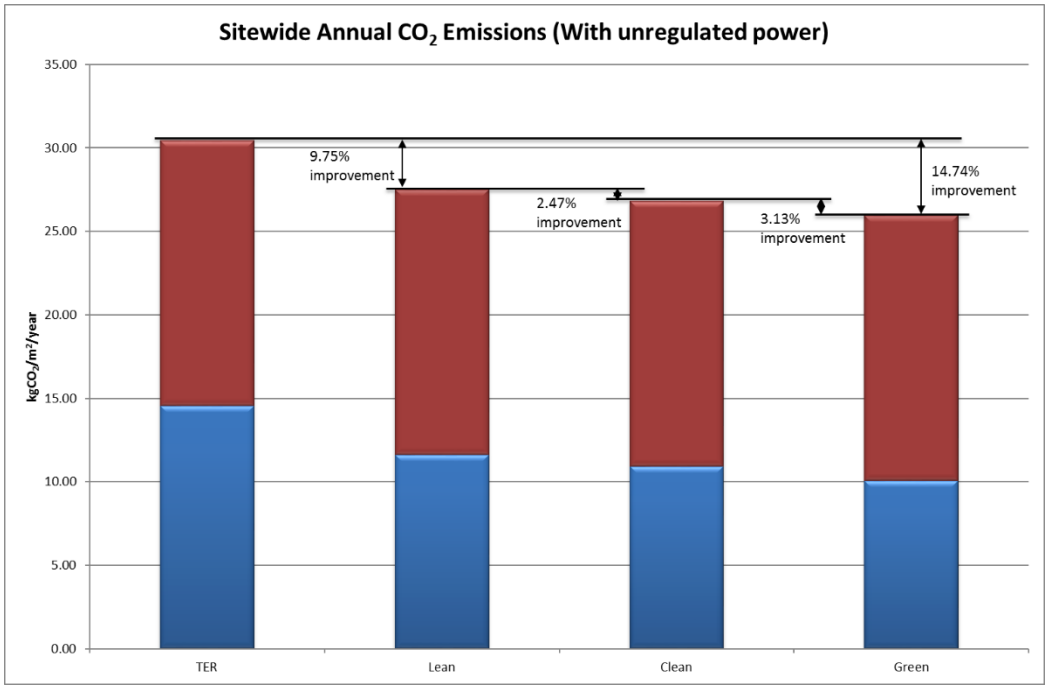
	kg CO_2/m^2			
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**Clean Scheme**	**Green Scheme**
Building Regulations Compliant	14.57	11.60	10.92	10.08
Allowing for Un-regulated Uses	30.46	27.49	26.81	25.97

These values are shown in diagrammatic form below that shows the following principles:

- The proposed green scheme (LZC) assessment shows a predicted improvement of 30.81% when compared to the baseline scheme
- The clean scheme shows a predicted improvement of 5.86% over the lean scheme
- The renewable energy technologies shows a predicted improvement of 7.69% over the clean scheme



When un-regulated energy uses are taken into account the predicted overall improvement is 14.74% compared to the baseline scheme.



Residential Apartments

The predicted annual CO_2 emissions data for the residential apartments is as follows:

	Tonnes CO_2/year			
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**Clean Scheme**	**Green Scheme**
Building Regulations Compliant	14.92	12.55	11.37	9.62
Allowing for Un-regulated Uses	33.93	31.56	30.38	28.63

The carbon emission savings as a result of the proposed measures based on the current design are predicted as follows:

	CO_2 Emission (tonnes CO_2/year)	**With Un-Regulated Uses CO_2 Emission (tonnes CO_2/year)**
Baseline scheme	140.77	320.13
Green scheme	90.76	270.12
Saving over baseline scheme	**50.01**	**50.01**

The regulated energy carbon emission savings when compared to the target savings are as follows:

	Regulated CO_2 Savings	
	Tonnes per Annum	**%**
Total Cumulative Savings	50.01	35.52
Total Target Savings	140.77	100.00
Annual Surplus/Shortfall	90.76	64.48

Hence there is a predicted annual shortfall of 90.76 tonnes CO_2/year.

Landlords Common Parts and Retail Unit

The predicted annual CO_2 emissions data for the landlords common areas and retail unit is as follows:

	Tonnes CO_2/year		
	Baseline Scheme	**Lean Scheme (with passive/low energy)**	**Clean Scheme**
Building Regulations Compliant	145.51	109.56	107.33
Allowing for Un-regulated Uses	278.23	242.28	240.05

The carbon emission savings as a result of the proposed measures based on the current design are predicted as follows:

	CO_2 Emission (tonnes CO_2/year)	**With Un-Regulated Uses CO_2 Emission (tonnes CO_2/year)**
Baseline scheme	145.51	278.23
Clean scheme	107.33	240.05
Saving over baseline scheme	**38.18**	**38.18**

The regulated energy carbon emission savings when compared to the target savings are as follows:

	Regulated CO_2 Savings	
	Tonnes per Annum	**%**
Total Cumulative Savings	38.18	26.24
Total Target Savings	50.93	35.00
Annual Surplus/Shortfall	12.75	8.76

Hence there is a predicted annual shortfall of 12.75 tonnes CO_2/year.

Therefore the total predicted annual shortfall is 103.51 tonnes CO_2/year for the development.

10.00 HEATING AND COOLING HIERARCHY

The hierarchy to be used for heating and cooling for the development is as follows:

Heating

- Decentralised energy centre serving the apartments and landlords common parts incorporating a CHP with backup gas fired high efficiency boilers as the primary heat source.
- The retail unit will utilise an air source heat pump.

Cooling

- Natural ventilation
- The retail unit will use an air source heat pump.

11.00 CONCLUSIONS

In line with the relevant planning policies and guidelines the energy strategy for the proposed development has adopted a hierarchical approach of using passive and low energy design technologies to reduce the baseline energy demand and hence CO_2 emissions followed by the application of clean and low and zero carbon technologies as appropriate.

The focus of the energy strategy is on CO_2 reduction from the building by adopting a highly efficient building envelope solution together with high efficiency mechanical and electrical services incorporating heat recovery. The renewable energy technologies assessment is based on using solutions that are technically proven with low maintenance implications taking into account the energy efficiency strategies being proposed in the current design.

The energy strategy also incorporates an overheating analysis of all apartment types in relation to CIBSE TM52: 2013. The analysis has proven that through the use of a high thermal mass external façade and additional openable windows the risk of overheating is reduced.

The analysis has shown that by incorporating passive and low energy design measures there is a predicted reduction in the development's annual CO_2 emissions, as indicated in the table below, from the baseline scheme.

Regulated CO_2 Savings	
Tonnes CO_2/Year	%
58.31	20.37

This is achieved by the following elements:

- High performance glazing
- Improved building fabric thermal insulation
- Low building air leakage rate ($3m^3/hr/m^2$ at 50 Pa which represents a 70 % improvement over the minimum 2013 Building Regulations requirements).
- High efficiency gas fired boilers
- Community heating system serving all apartments.
- Whole house mechanical supply and extract ventilation systems in each apartment with integral heat recovery
- Variable speed fans and pumps
- Low energy lighting (LED lamp sources) with PIR occupancy control
- Comprehensive energy management system
- Building management system to provide sophisticated energy efficiency controls

The potential use of de-centralised heating and power has been reviewed covering district heating, CHP and CCHP/trigeneration. The assessment has concluded there is sufficient demand within the development to justify the use of a CHP. In addition, pipework connectivity will be provided to connect into a suitable future district heating system.

Regulated CO_2 Savings	
Tonnes CO_2/Year	%
71.68	25.04

The potential renewable energy technologies have been assessed taking into account the particular development constraints. The strategy is to utilise:

- Photovoltaic cells located on the roof of the building to provide a contribution to the electrical demand for the residential apartments.
- Air source heat pump system to the retail unit to provide their heating and cooling demand.

The analysis has shown that by incorporating these renewable energy technologies in addition to the clean and passive and low energy design measures there is a predicted further reduction of annual CO_2 emissions from the clean scheme as indicated in the table below:

Regulated CO_2 Savings	
Tonnes CO_2/Year	%
88.19	30.81

The renewable energy technologies are currently predicted to achieve a 7.69% reduction in carbon emissions over the clean scheme based on regulated uses.

When the un-regulated uses are factored into the analysis then there is an overall predicted reduction of 14.74% in the developments annual CO_2 emissions.

The overall energy strategy identifies a predicted annual carbon emission saving of 88.19 tonnes over the baseline scheme (without unregulated energy).

There is a total predicted annual shortfall of 103.51 tonnes CO_2 for the development.

In terms of planning policy the energy strategy follows the current London Plan guidance together with the London Borough of Hillingdon policy. In overall terms the strategy doesn't fully achieve the current London Plan carbon dioxide emissions reduction levels due to the various site constraints, agreed building form and use of only minimum Building Regulations efficiency parameters for the retail unit with the shortfall identified above.

APPENDIX 1

Part L1A:2013 SAP Analysis

The below results are the figures taken from the SAP software which have been used to calculate the area weighted figures in the main report body.

	kgCO₂/m²/annum			
Apartment Type (references relate to different apartment types)	**Baseline**	**Lean**	**Clean**	**Green**
Ao	16.58	14.75	13.33	12.28
Bf	18.88	18.29	16.42	14.05
Cf	18.01	16.70	15.03	12.61
Df	14.72	13.59	12.72	11.07
Ef	15.08	14.19	12.83	10.96
Ff	16.84	16.17	14.55	12.84
Gf	13.72	11.72	10.64	9.15
Hf	17.64	16.49	14.85	12.43
I f	14.66	14.37	12.98	11.71
Jf	15.59	13.44	12.16	10.48
Kf	17.95	15.56	14.03	11.73
Lf	15.84	13.59	12.29	10.59
Mf	15.93	13.61	12.31	10.60
Nf	16.19	15.06	13.58	11.64
Of	17.53	16.64	14.97	12.98
Bo	16.68	13.96	12.62	10.25
Co	15.68	12.21	11.09	8.67
Do	12.66	10.04	9.19	7.53
Eo	12.99	10.43	9.53	7.67
Fo	14.60	11.75	10.68	8.97
Go	12.68	9.93	9.08	7.59
Ho	15.41	12.40	11.26	8.84
Io	15.27	11.94	10.85	9.58
Jo	13.44	10.63	9.70	8.02
Ko	15.77	12.63	11.46	9.05
Lo	13.67	10.73	9.79	8.09
Mo	13.75	10.73	9.79	8.08
No	14.01	11.09	10.10	8.16
Oo	15.25	12.26	11.13	9.14
Fr	16.84	15.12	13.64	11.93
Or	16.38	13.92	12.59	10.60
Br	18.88	17.27	15.53	13.16
Eo2	13.76	11.22	10.22	8.36
Hr	17.64	15.59	14.05	11.63
Ir	14.00	12.39	11.25	10.01
Po	13.53	11.03	10.03	8.81
Qo	14.18	11.65	10.59	9.06

	kgCO_2/m^2/annum			
Apartment Type (references relate to different apartment types)	**Baseline**	**Lean**	**Clean**	**Green**
GoE	13.50	10.86	9.89	8.40
Ro	15.21	12.87	11.68	9.70
Mr	14.30	11.46	10.42	8.72
Pr	14.95	13.20	11.93	10.71
Qr	16.36	14.94	13.47	11.94
Cr	18.01	15.61	14.07	11.65
Dr	14.72	12.77	11.58	9.92
Er2	15.91	14.30	12.92	11.06
GrE	15.66	14.05	12.69	11.20
Rr	15.43	13.17	11.93	9.96
Jr	15.59	13.69	12.37	10.70
Kr	17.95	15.81	11.57	11.84
Lr	15.84	13.83	12.51	10.80
Sr	15.51	13.45	12.17	10.59

APPENDIX 2

SAP Worksheets

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	02/07/2018
Address	A0 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)		Volume (m³)	
Lowest occupied		58.60	(1a)	x	4.20	(2a) =	246.12	(3a)
+1		57.12	(1b)	x	3.20	(2b) =	182.78	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	115.72	(4)					
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =	428.90	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			38.21	x	1.24	=	47.22			(27)
Exposed floor			58.60	x	0.19	=	11.08			(28b
External wall			38.95	x	0.15	=	5.84			(29a)
Party wall			80.36	x	0.00	=	0.00			(32)
External wall			76.32	x	0.14	=	10.68			(29a)
Total area of external elements ∑A, m²			212.08							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	74.82 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		31.81 (36)
Total fabric heat loss	(33) + (36) =	106.63 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
37.23	36.78	36.33	34.08	33.62	31.37	31.37	30.92	32.27	33.62	34.53	35.43	(38)

Heat transfer coefficient, W/K (37)m + (38)m

143.87	143.41	142.96	140.71	140.26	138.00	138.00	137.55	138.90	140.26	141.16	142.06	

Average = ∑(39)1...12/12 = 140.59 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.24	1.24	1.24	1.22	1.21	1.19	1.19	1.19	1.20	1.21	1.22	1.23	

Average = ∑(40)1...12/12 = 1.21 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.85 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.77 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
111.95	107.88	103.81	99.74	95.67	91.59	91.59	95.67	99.74	103.81	107.88	111.95	

∑(44)1...12 = 1221.27 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

166.02	145.20	149.83	130.63	125.34	108.16	100.23	115.01	116.38	135.63	148.06	160.78	

∑(45)1...12 = 1601.27 (45)

Distribution loss 0.15 x (45)m

24.90	21.78	22.48	19.59	18.80	16.22	15.03	17.25	17.46	20.35	22.21	24.12	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

198.27	174.33	182.09	161.84	157.59	139.37	132.48	147.26	147.60	167.89	179.27	193.03	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

198.27	174.33	182.09	161.84	157.59	139.37	132.48	147.26	147.60	167.89	179.27	193.03	

∑(64)1...12 = 1981.02 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

81.00	71.58	75.62	68.40	67.48	60.93	59.13	64.04	63.67	70.90	74.20	79.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.30	55.34	45.00	34.07	25.47	21.50	23.23	30.20	40.53	51.46	60.07	64.03	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.21	421.54	410.63	387.41	358.09	330.53	312.12	307.79	318.70	341.93	371.25	398.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	(71)
Water heating gains (Table 5)	108.87	106.52	101.64	95.00	90.70	84.63	79.47	86.08	88.43	95.30	103.05	106.53	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	700.21	695.22	669.09	628.30	586.07	548.48	526.65	535.89	559.48	600.51	646.19	681.19	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	38.21	x	36.79	x 0.9 x	0.50	x	0.90	=	438.43	(79)

Solar gains in watts ∑(74)m...(82)m

438.43	746.80	1021.81	1266.07	1418.11	1407.85	1357.32	1243.89	1106.40	825.38	525.14	375.20	(83)

Total gains - internal and solar (73)m + (83)m

1138.63	1442.02	1690.90	1894.37	2004.18	1956.33	1883.97	1779.78	1665.89	1425.89	1171.32	1056.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.78	0.62	0.45	0.32	0.35	0.56	0.84	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.98	20.26	20.56	20.82	20.95	20.99	21.00	21.00	20.98	20.79	20.33	19.93

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.89	19.89	19.89	19.91	19.91	19.93	19.93	19.93	19.92	19.91	19.90	19.90

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.94	0.87	0.74	0.56	0.37	0.24	0.27	0.48	0.79	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.57	18.97	19.38	19.72	19.87	19.92	19.93	19.93	19.90	19.70	19.09	18.50

(90)

Living area fraction — Living area ÷ (4) = 0.17 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.81	19.19	19.58	19.91	20.05	20.10	20.11	20.11	20.09	19.89	19.30	18.75

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.81	19.19	19.58	19.91	20.05	20.10	20.11	20.11	20.09	19.89	19.30	18.75

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.74	0.57	0.39	0.26	0.29	0.49	0.79	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	1108.13	1348.66	1462.33	1393.58	1133.34	754.98	483.74	509.64	817.22	1124.45	1105.30	1034.93	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2087.34	2049.12	1869.97	1549.43	1171.63	759.58	484.22	510.45	831.74	1302.30	1722.66	2066.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	728.53	470.71	303.28	112.21	28.49	0.00	0.00	0.00	0.00	132.32	444.50	767.48	

∑(98)1...5, 10...12 = 2987.52 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2987.52		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	3136.89	(307a)

Water heating

Annual water heating requirement	1981.02		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	2080.07	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	52.17	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	281.25		(330a)
Total electricity for the above, kWh/year		281.25	(331)
Electricity for lighting (Appendix L)		440.10	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5938.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	3136.89	x	4.24	x 0.01 =	133.00	(340a)
Water heating from boilers	2080.07	x	4.24	x 0.01 =	88.19	(342a)
Pumps and fans	281.25	x	13.19	x 0.01 =	37.10	(349)
Electricity for lighting	440.10	x	13.19	x 0.01 =	58.05	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		436.35	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.14	(357)
SAP value	84.09	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	5356.22	x	0.216	=	1156.94	(367)
Electrical energy for community heat distribution	52.17	x	0.519	=	27.08	(372)
Total CO2 associated with community systems					1184.02	(373)
Total CO2 associated with space and water heating					1184.02	(376)
Pumps and fans	281.25	x	0.519	=	145.97	(378)
Electricity for lighting	440.10	x	0.519	=	228.41	(379)
Total CO_2, kg/year				(376)..(382) =	1558.40	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.47	(384)
EI value					87.01	
EI rating (section 14)					87	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	5356.22	x	1.22	=	6534.59	(367)
Electrical energy for community heat distribution	52.17	x	3.07	=	160.16	(372)
Total primary energy associated with community systems					6694.75	(373)
Total primary energy associated with space and water heating					6694.75	(376)
Pumps and fans	281.25	x	3.07	=	863.45	(378)
Electricity for lighting	440.10	x	3.07	=	1351.12	(379)

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Primary energy kWh/year	8909.32	(383)
Dwelling primary energy rate kWh/m2/year	76.99	(384)

DRAFT

SAP Worksheet
Design - Draft

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Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	02/07/2018
Address	A0 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		58.60	(1a) x	4.20	(2a) =	246.12	(3a)
+1		57.12	(1b) x	3.20	(2b) =	182.78	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	115.72	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	428.90	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25

(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			38.21	x	1.24	=	47.22			(27)
Exposed floor			58.60	x	0.19	=	11.08			(28b
External wall			38.95	x	0.15	=	5.84			(29a)
Party wall			80.36	x	0.00	=	0.00			(32)
External wall			76.32	x	0.14	=	10.68			(29a)
Total area of external elements ∑A, m²			212.08							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	74.82 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		31.81 (36)
Total fabric heat loss	(33) + (36) =	106.63 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
37.23	36.78	36.33	34.08	33.62	31.37	31.37	30.92	32.27	33.62	34.53	35.43	(38)

Heat transfer coefficient, W/K (37)m + (38)m

143.87	143.41	142.96	140.71	140.26	138.00	138.00	137.55	138.90	140.26	141.16	142.06	

Average = ∑(39)1...12/12 = 140.59 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.24	1.24	1.24	1.22	1.21	1.19	1.19	1.19	1.20	1.21	1.22	1.23	

Average = ∑(40)1...12/12 = 1.21 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.85 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.77 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
111.95	107.88	103.81	99.74	95.67	91.59	91.59	95.67	99.74	103.81	107.88	111.95	

∑(44)1...12 = 1221.27 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

166.02	145.20	149.83	130.63	125.34	108.16	100.23	115.01	116.38	135.63	148.06	160.78	

∑(45)1...12 = 1601.27 (45)

Distribution loss 0.15 x (45)m

24.90	21.78	22.48	19.59	18.80	16.22	15.03	17.25	17.46	20.35	22.21	24.12	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

198.27	174.33	182.09	161.84	157.59	139.37	132.48	147.26	147.60	167.89	179.27	193.03	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

198.27	174.33	182.09	161.84	157.59	139.37	132.48	147.26	147.60	167.89	179.27	193.03	

∑(64)1...12 = 1981.02 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

81.00	71.58	75.62	68.40	67.48	60.93	59.13	64.04	63.67	70.90	74.20	79.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.30	55.34	45.00	34.07	25.47	21.50	23.23	30.20	40.53	51.46	60.07	64.03	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.21	421.54	410.63	387.41	358.09	330.53	312.12	307.79	318.70	341.93	371.25	398.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	(71)
Water heating gains (Table 5)	108.87	106.52	101.64	95.00	90.70	84.63	79.47	86.08	88.43	95.30	103.05	106.53	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	700.21	695.22	669.09	628.30	586.07	548.48	526.65	535.89	559.48	600.51	646.19	681.19	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	38.21	x	36.79	x 0.9 x	0.50	x	0.90	=	438.43	(79)

Solar gains in watts ∑(74)m...(82)m

438.43	746.80	1021.81	1266.07	1418.11	1407.85	1357.32	1243.89	1106.40	825.38	525.14	375.20	(83)

Total gains - internal and solar (73)m + (83)m

1138.63	1442.02	1690.90	1894.37	2004.18	1956.33	1883.97	1779.78	1665.89	1425.89	1171.32	1056.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.78	0.62	0.45	0.32	0.35	0.56	0.84	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.98	20.26	20.56	20.82	20.95	20.99	21.00	21.00	20.98	20.79	20.33	19.93

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.89	19.89	19.89	19.91	19.91	19.93	19.93	19.93	19.92	19.91	19.90	19.90

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.94	0.87	0.74	0.56	0.37	0.24	0.27	0.48	0.79	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.57	18.97	19.38	19.72	19.87	19.92	19.93	19.93	19.90	19.70	19.09	18.50

(90)

Living area fraction — Living area ÷ (4) = 0.17 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.81	19.19	19.58	19.91	20.05	20.10	20.11	20.11	20.09	19.89	19.30	18.75

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.81	19.19	19.58	19.91	20.05	20.10	20.11	20.11	20.09	19.89	19.30	18.75

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.74	0.57	0.39	0.26	0.29	0.49	0.79	0.94	0.98
												(94)
Useful gains, ηmGm, W (94)m x (84)m	1108.13	1348.66	1462.33	1393.58	1133.34	754.98	483.74	509.64	817.22	1124.45	1105.30	1034.93
												(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
												(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2087.34	2049.12	1869.97	1549.43	1171.63	759.58	484.22	510.45	831.74	1302.30	1722.66	2066.48
												(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	728.53	470.71	303.28	112.21	28.49	0.00	0.00	0.00	0.00	132.32	444.50	767.48

∑(98)1...5, 10...12 = 2987.52 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2987.52		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	627.38	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	2509.51	(307b)

Water heating

Annual water heating requirement	1981.02		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	416.01	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1664.06	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	52.17	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	281.25	(330a)
Total electricity for the above, kWh/year	281.25	(331)
Electricity for lighting (Appendix L)	440.10	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5938.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	627.38	x	2.97	x 0.01 =	18.63	(340a)
Space heating from boilers	2509.51	x	4.24	x 0.01 =	106.40	(340b)
Water heating from CHP	416.01	x	2.97	x 0.01 =	12.36	(342a)
Water heating from boilers	1664.06	x	4.24	x 0.01 =	70.56	(342b)
Pumps and fans	281.25	x	13.19	x 0.01 =	37.10	(349)
Electricity for lighting	440.10	x	13.19	x 0.01 =	58.05	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		423.09	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.11	(357)
SAP value	84.58	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1160.8633	x	0.2160	=	250.7465	(363)
less credit emissions for electricity		-384.8946	x	0.5190	=	-199.7603	(364)
Water heated by CHP		769.7672	x	0.2160	=	166.2697	(365)
less credit emissions for electricity		-255.2232	x	0.5190	=	-132.4608	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	4284.98	x	0.216	=	925.56	(368)
Electrical energy for community heat distribution		52.17	x	0.519	=	27.08	(372)
Total CO2 associated with community systems						1037.43	(373)
Total CO2 associated with space and water heating						1037.43	(376)
Pumps and fans		281.25	x	0.519	=	145.97	(378)
Electricity for lighting		440.10	x	0.519	=	228.41	(379)
Total CO_2, kg/year					(376)..(382) =	1411.81	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.20	(384)
EI value						88.23	

EI rating (section 14)	88	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1160.86	x	1.22	=	1416.25	(363)
less credit energy for electricity		-384.89	x	3.07	=	-1181.63	(364)
Water heated by CHP		769.77	x	1.22	=	939.12	(365)
less credit energy for electricity		-255.22	x	3.07	=	-783.54	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	4284.98	x	1.22	=	5227.67	(368)
Electrical energy for community heat distribution		52.17	x	3.07	=	160.16	(372)
Total primary energy associated with community systems						5778.04	(373)
Total primary energy associated with space and water heating						5778.04	(376)
Pumps and fans		281.25	x	3.07	=	863.45	(378)
Electricity for lighting		440.10	x	3.07	=	1351.12	(379)
Primary energy kWh/year						7992.61	(383)
Dwelling primary energy rate kWh/m2/year						69.07	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	A0 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		58.60	(1a) x	4.20	(2a) =	246.12	(3a)
+1		57.12	(1b) x	3.20	(2b) =	182.78	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	115.72	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	428.90	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			38.21	x	1.24	=	47.22			(27)
Exposed floor			58.60	x	0.19	=	11.08			(28b
External wall			38.95	x	0.15	=	5.84			(29a)
Party wall			80.36	x	0.00	=	0.00			(32)
External wall			76.32	x	0.14	=	10.68			(29a)
Total area of external elements ∑A, m²			212.08							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	74.82 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		31.81 (36)
Total fabric heat loss	(33) + (36) =	106.63 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
37.23	36.78	36.33	34.08	33.62	31.37	31.37	30.92	32.27	33.62	34.53	35.43	(38)

Heat transfer coefficient, W/K (37)m + (38)m

143.87	143.41	142.96	140.71	140.26	138.00	138.00	137.55	138.90	140.26	141.16	142.06	

Average = ∑(39)1...12/12 = 140.59 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.24	1.24	1.24	1.22	1.21	1.19	1.19	1.19	1.20	1.21	1.22	1.23	

Average = ∑(40)1...12/12 = 1.21 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.85 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.77 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
111.95	107.88	103.81	99.74	95.67	91.59	91.59	95.67	99.74	103.81	107.88	111.95	

∑(44)1...12 = 1221.27 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

166.02	145.20	149.83	130.63	125.34	108.16	100.23	115.01	116.38	135.63	148.06	160.78	

∑(45)1...12 = 1601.27 (45)

Distribution loss 0.15 x (45)m

24.90	21.78	22.48	19.59	18.80	16.22	15.03	17.25	17.46	20.35	22.21	24.12	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

198.27	174.33	182.09	161.84	157.59	139.37	132.48	147.26	147.60	167.89	179.27	193.03	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

198.27	174.33	182.09	161.84	157.59	139.37	132.48	147.26	147.60	167.89	179.27	193.03	

∑(64)1...12 = 1981.02 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

81.00	71.58	75.62	68.40	67.48	60.93	59.13	64.04	63.67	70.90	74.20	79.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	170.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.30	55.34	45.00	34.07	25.47	21.50	23.23	30.20	40.53	51.46	60.07	64.03	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.21	421.54	410.63	387.41	358.09	330.53	312.12	307.79	318.70	341.93	371.25	398.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	54.92	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	-113.81	(71)
Water heating gains (Table 5)	108.87	106.52	101.64	95.00	90.70	84.63	79.47	86.08	88.43	95.30	103.05	106.53	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	700.21	695.22	669.09	628.30	586.07	548.48	526.65	535.89	559.48	600.51	646.19	681.19	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	38.21	x	36.79	x 0.9 x	0.50	x	0.90	=	438.43	(79)

Solar gains in watts ∑(74)m...(82)m

438.43	746.80	1021.81	1266.07	1418.11	1407.85	1357.32	1243.89	1106.40	825.38	525.14	375.20	(83)

Total gains - internal and solar (73)m + (83)m

1138.63	1442.02	1690.90	1894.37	2004.18	1956.33	1883.97	1779.78	1665.89	1425.89	1171.32	1056.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.78	0.62	0.45	0.32	0.35	0.56	0.84	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.98	20.26	20.56	20.82	20.95	20.99	21.00	21.00	20.98	20.79	20.33	19.93

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.89	19.89	19.89	19.91	19.91	19.93	19.93	19.93	19.92	19.91	19.90	19.90

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.94	0.87	0.74	0.56	0.37	0.24	0.27	0.48	0.79	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.57	18.97	19.38	19.72	19.87	19.92	19.93	19.93	19.90	19.70	19.09	18.50

(90)

Living area fraction — Living area ÷ (4) = 0.17 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.81	19.19	19.58	19.91	20.05	20.10	20.11	20.11	20.09	19.89	19.30	18.75

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.81	19.19	19.58	19.91	20.05	20.10	20.11	20.11	20.09	19.89	19.30	18.75

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.74	0.57	0.39	0.26	0.29	0.49	0.79	0.94	0.98
												(94)
Useful gains, ηmGm, W (94)m x (84)m	1108.13	1348.66	1462.33	1393.58	1133.34	754.98	483.74	509.64	817.22	1124.45	1105.30	1034.93
												(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
												(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2087.34	2049.12	1869.97	1549.43	1171.63	759.58	484.22	510.45	831.74	1302.30	1722.66	2066.48
												(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	728.53	470.71	303.28	112.21	28.49	0.00	0.00	0.00	0.00	132.32	444.50	767.48

∑(98)1...5, 10...12 = 2987.52 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	2987.52		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	627.38	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	2509.51	(307b)

Water heating

Annual water heating requirement	1981.02		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	416.01	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1664.06	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	52.17	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	281.25		(330a)
Total electricity for the above, kWh/year		281.25	(331)
Electricity for lighting (Appendix L)		440.10	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5705.14	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	627.38	x	2.97	x 0.01 =	18.63	(340a)
Space heating from boilers	2509.51	x	4.24	x 0.01 =	106.40	(340b)
Water heating from CHP	416.01	x	2.97	x 0.01 =	12.36	(342a)
Water heating from boilers	1664.06	x	4.24	x 0.01 =	70.56	(342b)
Pumps and fans	281.25	x	13.19	x 0.01 =	37.10	(349)
Electricity for lighting	440.10	x	13.19	x 0.01 =	58.05	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		423.09	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.11	(357)
SAP value	84.58	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1160.8633	x	0.2160	=	250.7465	(363)
less credit emissions for electricity		-384.8946	x	0.5190	=	-199.7603	(364)
Water heated by CHP		769.7672	x	0.2160	=	166.2697	(365)
less credit emissions for electricity		-255.2232	x	0.5190	=	-132.4608	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	4284.98	x	0.216	=	925.56	(368)
Electrical energy for community heat distribution		52.17	x	0.519	=	27.08	(372)
Total CO2 associated with community systems						1037.43	(373)
Total CO2 associated with space and water heating						1037.43	(376)
Pumps and fans		281.25	x	0.519	=	145.97	(378)

Electricity for lighting		440.10	x	0.519	=	228.41	(379)
Energy saving/generation technologies							
pv savings		-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year					(376)..(382) =	1290.79	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.15	(384)
EI value						89.24	
EI rating (section 14)						89	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	1160.86	x	1.22	=	1416.25	(363)
less credit energy for electricity		-384.89	x	3.07	=	-1181.63	(364)
Water heated by CHP		769.77	x	1.22	=	939.12	(365)
less credit energy for electricity		-255.22	x	3.07	=	-783.54	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	4284.98	x	1.22	=	5227.67	(368)
Electrical energy for community heat distribution		52.17	x	3.07	=	160.16	(372)
Total primary energy associated with community systems						5778.04	(373)
Total primary energy associated with space and water heating						5778.04	(376)
Pumps and fans		281.25	x	3.07	=	863.45	(378)
Electricity for lighting		440.10	x	3.07	=	1351.12	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						7276.75	(383)
Dwelling primary energy rate kWh/m2/year						62.88	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Bf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
Exposed floor			51.00	x	0.20	=	10.20			(28b
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			106.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	33.72 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.90 (36)
Total fabric heat loss	(33) + (36) =	49.62 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.68	60.55	60.42	59.75	59.61	58.94	58.94	58.81	59.21	59.61	59.88	60.15	

Average = ∑(39)1...12/12 = 59.71 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.19	1.19	1.18	1.17	1.17	1.16	1.16	1.15	1.16	1.17	1.17	1.18	

Average = ∑(40)1...12/12 = 1.17 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.80	0.64	0.46	0.33	0.37	0.59	0.85	0.96	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.10	20.29	20.55	20.81	20.95	20.99	21.00	21.00	20.97	20.78	20.40	20.06

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.93	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.95	0.89	0.76	0.58	0.39	0.25	0.29	0.51	0.81	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.78	19.05	19.40	19.75	19.90	19.95	19.96	19.96	19.93	19.72	19.21	18.73

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.35	19.59	19.90	20.21	20.35	20.40	20.41	20.41	20.38	20.18	19.72	19.30

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.35	19.59	19.90	20.21	20.35	20.40	20.41	20.41	20.38	20.18	19.72	19.30

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.97	0.94	0.89	0.77	0.60	0.42	0.29	0.32	0.55	0.82	0.94	0.97
(94)												
Useful gains, ηmGm, W (94)m x (84)m	517.25	578.88	613.73	595.27	495.82	339.28	223.97	235.00	362.55	481.44	496.15	494.00
(95)												
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
(96)												
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	913.32	889.26	809.44	675.43	515.85	341.86	224.29	235.57	371.94	571.11	755.97	908.43
(97)												
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	294.68	208.57	145.61	57.72	14.91	0.00	0.00	0.00	0.00	66.71	187.07	308.33

∑(98)1...5, 10...12 = 1283.61 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.17 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1283.61		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1347.79	(307a)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1638.44	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.86	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	77.78		(330a)
Total electricity for the above, kWh/year		77.78	(331)
Electricity for lighting (Appendix L)		235.90	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3299.90	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1347.79	x	4.24	x 0.01 =	57.15	(340a)
Water heating from boilers	1638.44	x	4.24	x 0.01 =	69.47	(342a)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		287.99	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.26	(357)
SAP value	82.42	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3065.94	x	0.216	=	662.24	(367)
Electrical energy for community heat distribution	29.86	x	0.519	=	15.50	(372)
Total CO2 associated with community systems					677.74	(373)
Total CO2 associated with space and water heating					677.74	(376)
Pumps and fans	77.78	x	0.519	=	40.37	(378)
Electricity for lighting	235.90	x	0.519	=	122.43	(379)
Total CO_2, kg/year				(376)..(382) =	840.54	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	16.48	(384)
EI value					88.27	
EI rating (section 14)					88	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3065.94	x	1.22	=	3740.44	(367)
Electrical energy for community heat distribution	29.86	x	3.07	=	91.68	(372)
Total primary energy associated with community systems					3832.12	(373)
Total primary energy associated with space and water heating					3832.12	(376)
Pumps and fans	77.78	x	3.07	=	238.77	(378)
Electricity for lighting	235.90	x	3.07	=	724.21	(379)

Primary energy kWh/year	4795.10	(383)
Dwelling primary energy rate kWh/m2/year	94.02	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Bf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
Exposed floor			51.00	x	0.20	=	10.20			(28b
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			106.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	33.72 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.90 (36)
Total fabric heat loss	(33) + (36) =	49.62 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.68	60.55	60.42	59.75	59.61	58.94	58.94	58.81	59.21	59.61	59.88	60.15	

Average = ∑(39)1...12/12 = 59.71 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.19	1.19	1.18	1.17	1.17	1.16	1.16	1.15	1.16	1.17	1.17	1.18	

Average = ∑(40)1...12/12 = 1.17 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.80	0.64	0.46	0.33	0.37	0.59	0.85	0.96	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.10	20.29	20.55	20.81	20.95	20.99	21.00	21.00	20.97	20.78	20.40	20.06

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.93	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.95	0.89	0.76	0.58	0.39	0.25	0.29	0.51	0.81	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.78	19.05	19.40	19.75	19.90	19.95	19.96	19.96	19.93	19.72	19.21	18.73

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.35	19.59	19.90	20.21	20.35	20.40	20.41	20.41	20.38	20.18	19.72	19.30

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.35	19.59	19.90	20.21	20.35	20.40	20.41	20.41	20.38	20.18	19.72	19.30

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.89	0.77	0.60	0.42	0.29	0.32	0.55	0.82	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	517.25	578.88	613.73	595.27	495.82	339.28	223.97	235.00	362.55	481.44	496.15	494.00	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	913.32	889.26	809.44	675.43	515.85	341.86	224.29	235.57	371.94	571.11	755.97	908.43	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	294.68	208.57	145.61	57.72	14.91	0.00	0.00	0.00	0.00	66.71	187.07	308.33	

∑(98)1...5, 10...12 = 1283.61 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.17 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1283.61		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	269.56	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1078.23	(307b)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	327.69	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1310.75	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.86	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	77.78	(330a)
Total electricity for the above, kWh/year	77.78	(331)
Electricity for lighting (Appendix L)	235.90	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3299.90	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	269.56	x	2.97	x 0.01 =	8.01	(340a)
Space heating from boilers	1078.23	x	4.24	x 0.01 =	45.72	(340b)
Water heating from CHP	327.69	x	2.97	x 0.01 =	9.73	(342a)
Water heating from boilers	1310.75	x	4.24	x 0.01 =	55.58	(342b)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		280.40	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.23	(357)
SAP value	82.89	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	498.7734	x	0.2160	=	107.7350	(363)
less credit emissions for electricity		-165.3728	x	0.5190	=	-85.8285	(364)
Water heated by CHP		606.3326	x	0.2160	=	130.9678	(365)
less credit emissions for electricity		-201.0350	x	0.5190	=	-104.3372	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2452.75	x	0.216	=	529.79	(368)
Electrical energy for community heat distribution		29.86	x	0.519	=	15.50	(372)
Total CO2 associated with community systems						593.83	(373)
Total CO2 associated with space and water heating						593.83	(376)
Pumps and fans		77.78	x	0.519	=	40.37	(378)
Electricity for lighting		235.90	x	0.519	=	122.43	(379)
Total CO_2, kg/year					(376)..(382) =	756.63	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	14.84	(384)
EI value						89.44	

EI rating (section 14)	89	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	498.77	x	1.22	=	608.50	(363)
less credit energy for electricity		-165.37	x	3.07	=	-507.69	(364)
Water heated by CHP		606.33	x	1.22	=	739.73	(365)
less credit energy for electricity		-201.03	x	3.07	=	-617.18	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2452.75	x	1.22	=	2992.36	(368)
Electrical energy for community heat distribution		29.86	x	3.07	=	91.68	(372)
Total primary energy associated with community systems						3307.39	(373)
Total primary energy associated with space and water heating						3307.39	(376)
Pumps and fans		77.78	x	3.07	=	238.77	(378)
Electricity for lighting		235.90	x	3.07	=	724.21	(379)
Primary energy kWh/year						4270.37	(383)
Dwelling primary energy rate kWh/m2/year						83.73	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Bf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
Exposed floor			51.00	x	0.20	=	10.20			(28b
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			106.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	33.72 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.90 (36)
Total fabric heat loss	(33) + (36) =	49.62 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.68	60.55	60.42	59.75	59.61	58.94	58.94	58.81	59.21	59.61	59.88	60.15	

Average = ∑(39)1...12/12 = 59.71 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.19	1.19	1.18	1.17	1.17	1.16	1.16	1.15	1.16	1.17	1.17	1.18	

Average = ∑(40)1...12/12 = 1.17 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.80	0.64	0.46	0.33	0.37	0.59	0.85	0.96	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.10	20.29	20.55	20.81	20.95	20.99	21.00	21.00	20.97	20.78	20.40	20.06

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.93	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.95	0.89	0.76	0.58	0.39	0.25	0.29	0.51	0.81	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.78	19.05	19.40	19.75	19.90	19.95	19.96	19.96	19.93	19.72	19.21	18.73

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.35	19.59	19.90	20.21	20.35	20.40	20.41	20.41	20.38	20.18	19.72	19.30

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.35	19.59	19.90	20.21	20.35	20.40	20.41	20.41	20.38	20.18	19.72	19.30

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.89	0.77	0.60	0.42	0.29	0.32	0.55	0.82	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	517.25	578.88	613.73	595.27	495.82	339.28	223.97	235.00	362.55	481.44	496.15	494.00	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	913.32	889.26	809.44	675.43	515.85	341.86	224.29	235.57	371.94	571.11	755.97	908.43	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	294.68	208.57	145.61	57.72	14.91	0.00	0.00	0.00	0.00	66.71	187.07	308.33	

∑(98)1...5, 10...12 = 1283.61 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.17 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1283.61		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	269.56	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1078.23	(307b)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	327.69	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1310.75	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.86	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	77.78		(330a)
Total electricity for the above, kWh/year		77.78	(331)
Electricity for lighting (Appendix L)		235.90	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3066.72	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	269.56	x	2.97	x 0.01 =	8.01	(340a)
Space heating from boilers	1078.23	x	4.24	x 0.01 =	45.72	(340b)
Water heating from CHP	327.69	x	2.97	x 0.01 =	9.73	(342a)
Water heating from boilers	1310.75	x	4.24	x 0.01 =	55.58	(342b)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		280.40	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.23	(357)
SAP value	82.89	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	498.7734	x	0.2160	=	107.7350	(363)
less credit emissions for electricity		-165.3728	x	0.5190	=	-85.8285	(364)
Water heated by CHP		606.3326	x	0.2160	=	130.9678	(365)
less credit emissions for electricity		-201.0350	x	0.5190	=	-104.3372	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2452.75	x	0.216	=	529.79	(368)
Electrical energy for community heat distribution		29.86	x	0.519	=	15.50	(372)
Total CO2 associated with community systems						593.83	(373)
Total CO2 associated with space and water heating						593.83	(376)
Pumps and fans		77.78	x	0.519	=	40.37	(378)

Electricity for lighting	235.90	x	0.519	=	122.43	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	635.61	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.46	(384)
EI value					91.13	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	498.77	x	1.22	=	608.50	(363)
less credit energy for electricity		-165.37	x	3.07	=	-507.69	(364)
Water heated by CHP		606.33	x	1.22	=	739.73	(365)
less credit energy for electricity		-201.03	x	3.07	=	-617.18	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2452.75	x	1.22	=	2992.36	(368)
Electrical energy for community heat distribution		29.86	x	3.07	=	91.68	(372)
Total primary energy associated with community systems						3307.39	(373)
Total primary energy associated with space and water heating						3307.39	(376)
Pumps and fans		77.78	x	3.07	=	238.77	(378)
Electricity for lighting		235.90	x	3.07	=	724.21	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3554.51	(383)
Dwelling primary energy rate kWh/m2/year						69.70	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Bo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			55.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.25 (36)
Total fabric heat loss	(33) + (36) =	31.77 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.83	42.70	42.57	41.90	41.76	41.09	41.09	40.96	41.36	41.76	42.03	42.30	

Average = ∑(39)1...12/12 = 41.86 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.83	0.82	0.82	0.81	0.81	0.80	0.81	0.82	0.82	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.91	0.81	0.64	0.47	0.32	0.23	0.26	0.43	0.71	0.91	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.60	20.75	20.89	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.57

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.24	20.24	20.23	20.23

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.95	0.89	0.79	0.61	0.43	0.28	0.19	0.22	0.38	0.67	0.89	0.96

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.72	19.92	20.10	20.21	20.23	20.25	20.25	20.25	20.24	20.21	19.99	19.68

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.10	20.28	20.44	20.54	20.56	20.57	20.57	20.57	20.57	20.53	20.34	20.06

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.10	20.28	20.44	20.54	20.56	20.57	20.57	20.57	20.57	20.53	20.34	20.06

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.89	0.79	0.62	0.45	0.30	0.21	0.24	0.40	0.69	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	505.05	549.00	547.88	478.84	369.17	245.36	163.23	170.94	267.19	401.79	469.26	484.82	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	676.70	656.57	593.51	487.78	370.16	245.41	163.24	170.95	267.55	414.85	556.34	670.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	127.71	72.29	33.95	6.44	0.73	0.00	0.00	0.00	0.00	9.72	62.70	138.46	

∑(98)1...5, 10...12 = 452.00 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.86 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	452.00		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	474.60	(307a)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1638.44	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	21.13	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	77.78	(330a)

Total electricity for the above, kWh/year		77.78	(331)
Electricity for lighting (Appendix L)		235.90	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2426.71	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	474.60	x	4.24	x 0.01 =	20.12	(340a)
Water heating from boilers	1638.44	x	4.24	x 0.01 =	69.47	(342a)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		250.97	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.68	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2169.44	x	0.216	=	468.60	(367)
Electrical energy for community heat distribution		21.13	x	0.519	=	10.97	(372)
Total CO2 associated with community systems						479.57	(373)
Total CO2 associated with space and water heating						479.57	(376)
Pumps and fans		77.78	x	0.519	=	40.37	(378)
Electricity for lighting		235.90	x	0.519	=	122.43	(379)
Total CO_2, kg/year					(376)..(382) =	642.36	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.60	(384)
EI value						91.03	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2169.44	x	1.22	=	2646.72	(367)
Electrical energy for community heat distribution		21.13	x	3.07	=	64.87	(372)
Total primary energy associated with community systems						2711.59	(373)
Total primary energy associated with space and water heating						2711.59	(376)
Pumps and fans		77.78	x	3.07	=	238.77	(378)
Electricity for lighting		235.90	x	3.07	=	724.21	(379)
Primary energy kWh/year						3674.56	(383)

Dwelling primary energy rate kWh/m2/year	72.05	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Bo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			55.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.25 (36)
Total fabric heat loss	(33) + (36) =	31.77 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.83	42.70	42.57	41.90	41.76	41.09	41.09	40.96	41.36	41.76	42.03	42.30	

Average = ∑(39)1...12/12 = 41.86 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.83	0.82	0.82	0.81	0.81	0.80	0.81	0.82	0.82	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.91	0.81	0.64	0.47	0.32	0.23	0.26	0.43	0.71	0.91	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.60	20.75	20.89	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.57

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.24	20.24	20.23	20.23

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.95	0.89	0.79	0.61	0.43	0.28	0.19	0.22	0.38	0.67	0.89	0.96

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.72	19.92	20.10	20.21	20.23	20.25	20.25	20.25	20.24	20.21	19.99	19.68

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.10	20.28	20.44	20.54	20.56	20.57	20.57	20.57	20.57	20.53	20.34	20.06

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.10	20.28	20.44	20.54	20.56	20.57	20.57	20.57	20.57	20.53	20.34	20.06

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.89	0.79	0.62	0.45	0.30	0.21	0.24	0.40	0.69	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	505.05	549.00	547.88	478.84	369.17	245.36	163.23	170.94	267.19	401.79	469.26	484.82	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	676.70	656.57	593.51	487.78	370.16	245.41	163.24	170.95	267.55	414.85	556.34	670.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	127.71	72.29	33.95	6.44	0.73	0.00	0.00	0.00	0.00	9.72	62.70	138.46	

∑(98)1...5, 10...12 = 452.00 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.86 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	452.00		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	94.92	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	379.68	(307b)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	327.69	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1310.75	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	21.13	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	77.78	(330a)
Total electricity for the above, kWh/year	77.78	(331)
Electricity for lighting (Appendix L)	235.90	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) = 2426.71	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	94.92	x	2.97	x 0.01 =	2.82	(340a)
Space heating from boilers	379.68	x	4.24	x 0.01 =	16.10	(340b)
Water heating from CHP	327.69	x	2.97	x 0.01 =	9.73	(342a)
Water heating from boilers	1310.75	x	4.24	x 0.01 =	55.58	(342b)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		245.60	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.01	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	175.6339	x	0.2160	=	37.9369	(363)
less credit emissions for electricity		-58.2330	x	0.5190	=	-30.2229	(364)
Water heated by CHP		606.3326	x	0.2160	=	130.9678	(365)
less credit emissions for electricity		-201.0350	x	0.5190	=	-104.3372	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1735.55	x	0.216	=	374.88	(368)
Electrical energy for community heat distribution		21.13	x	0.519	=	10.97	(372)
Total CO2 associated with community systems						420.19	(373)
Total CO2 associated with space and water heating						420.19	(376)
Pumps and fans		77.78	x	0.519	=	40.37	(378)
Electricity for lighting		235.90	x	0.519	=	122.43	(379)
Total CO_2, kg/year					(376)..(382) =	582.99	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.43	(384)
EI value						91.86	
EI rating (section 14)						92	(385)

EI band	A

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	175.63	x	1.22	=	214.27	(363)
less credit energy for electricity		-58.23	x	3.07	=	-178.78	(364)
Water heated by CHP		606.33	x	1.22	=	739.73	(365)
less credit energy for electricity		-201.03	x	3.07	=	-617.18	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1735.55	x	1.22	=	2117.37	(368)
Electrical energy for community heat distribution		21.13	x	3.07	=	64.87	(372)
Total primary energy associated with community systems						2340.29	(373)
Total primary energy associated with space and water heating						2340.29	(376)
Pumps and fans		77.78	x	3.07	=	238.77	(378)
Electricity for lighting		235.90	x	3.07	=	724.21	(379)
Primary energy kWh/year						3303.27	(383)
Dwelling primary energy rate kWh/m2/year						64.77	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Bo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			55.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.25 (36)
Total fabric heat loss	(33) + (36) =	31.77 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.83	42.70	42.57	41.90	41.76	41.09	41.09	40.96	41.36	41.76	42.03	42.30	

Average = ∑(39)1...12/12 = 41.86 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.83	0.82	0.82	0.81	0.81	0.80	0.81	0.82	0.82	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.91	0.81	0.64	0.47	0.32	0.23	0.26	0.43	0.71	0.91	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.60	20.75	20.89	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.57

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.24	20.24	20.23	20.23

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.95	0.89	0.79	0.61	0.43	0.28	0.19	0.22	0.38	0.67	0.89	0.96

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.72	19.92	20.10	20.21	20.23	20.25	20.25	20.25	20.24	20.21	19.99	19.68

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.10	20.28	20.44	20.54	20.56	20.57	20.57	20.57	20.57	20.53	20.34	20.06

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.10	20.28	20.44	20.54	20.56	20.57	20.57	20.57	20.57	20.53	20.34	20.06

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.89	0.79	0.62	0.45	0.30	0.21	0.24	0.40	0.69	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	505.05	549.00	547.88	478.84	369.17	245.36	163.23	170.94	267.19	401.79	469.26	484.82	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	676.70	656.57	593.51	487.78	370.16	245.41	163.24	170.95	267.55	414.85	556.34	670.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	127.71	72.29	33.95	6.44	0.73	0.00	0.00	0.00	0.00	9.72	62.70	138.46	

∑(98)1...5, 10...12 = 452.00 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.86 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	452.00		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	94.92	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	379.68	(307b)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	327.69	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1310.75	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	21.13	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	77.78		(330a)
Total electricity for the above, kWh/year		77.78	(331)
Electricity for lighting (Appendix L)		235.90	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2193.53	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	94.92	x	2.97	x 0.01 =	2.82	(340a)
Space heating from boilers	379.68	x	4.24	x 0.01 =	16.10	(340b)
Water heating from CHP	327.69	x	2.97	x 0.01 =	9.73	(342a)
Water heating from boilers	1310.75	x	4.24	x 0.01 =	55.58	(342b)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		245.60	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.01	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	175.6339	x	0.2160	=	37.9369	(363)
less credit emissions for electricity		-58.2330	x	0.5190	=	-30.2229	(364)
Water heated by CHP		606.3326	x	0.2160	=	130.9678	(365)
less credit emissions for electricity		-201.0350	x	0.5190	=	-104.3372	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1735.55	x	0.216	=	374.88	(368)
Electrical energy for community heat distribution		21.13	x	0.519	=	10.97	(372)
Total CO2 associated with community systems						420.19	(373)
Total CO2 associated with space and water heating						420.19	(376)
Pumps and fans		77.78	x	0.519	=	40.37	(378)
Electricity for lighting		235.90	x	0.519	=	122.43	(379)

Energy saving/generation technologies							
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	461.97	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.06	(384)
EI value					93.55	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	175.63	x	1.22	=	214.27	(363)
less credit energy for electricity		-58.23	x	3.07	=	-178.78	(364)
Water heated by CHP		606.33	x	1.22	=	739.73	(365)
less credit energy for electricity		-201.03	x	3.07	=	-617.18	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1735.55	x	1.22	=	2117.37	(368)
Electrical energy for community heat distribution		21.13	x	3.07	=	64.87	(372)
Total primary energy associated with community systems						2340.29	(373)
Total primary energy associated with space and water heating						2340.29	(376)
Pumps and fans		77.78	x	3.07	=	238.77	(378)
Electricity for lighting		235.90	x	3.07	=	724.21	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2587.41	(383)
Dwelling primary energy rate kWh/m2/year						50.73	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Br 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Roof			51.00	x	0.12	=	6.12			(30)
Total area of external elements ∑A, m²			106.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.64 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.90 (36)
Total fabric heat loss	(33) + (36) =	45.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.60	56.47	56.34	55.67	55.53	54.86	54.86	54.73	55.13	55.53	55.80	56.07	

Average = ∑(39)1...12/12 = 55.63 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.11	1.11	1.10	1.09	1.09	1.08	1.08	1.07	1.08	1.09	1.09	1.10	

Average = ∑(40)1...12/12 = 1.09 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.90	0.78	0.60	0.43	0.31	0.35	0.56	0.83	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.21	20.40	20.64	20.86	20.97	21.00	21.00	21.00	20.98	20.83	20.49	20.17

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.99	19.99	20.00	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20.00

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.94	0.88	0.74	0.55	0.36	0.24	0.27	0.49	0.79	0.94	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.99	19.25	19.57	19.87	19.98	20.02	20.02	20.02	20.01	19.84	19.39	18.94

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.52	19.74	20.03	20.30	20.41	20.44	20.44	20.44	20.43	20.27	19.87	19.47

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.52	19.74	20.03	20.30	20.41	20.44	20.44	20.44	20.43	20.27	19.87	19.47

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.88	0.75	0.57	0.39	0.27	0.31	0.52	0.80	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	515.95	575.44	605.17	576.59	471.00	319.00	210.67	221.01	343.19	469.69	493.09	493.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	861.29	838.26	762.33	634.36	483.55	320.38	210.82	221.30	348.83	537.09	712.28	856.18	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	256.93	176.61	116.93	41.60	9.33	0.00	0.00	0.00	0.00	50.15	157.82	270.16	

∑(98)1...5, 10...12 = 1079.53 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.17 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1079.53		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1133.51	(307a)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1638.44	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.72	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	77.78		(330a)
Total electricity for the above, kWh/year		77.78	(331)
Electricity for lighting (Appendix L)		235.90	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3085.61	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1133.51	x	4.24	x 0.01 =	48.06	(340a)
Water heating from boilers	1638.44	x	4.24	x 0.01 =	69.47	(342a)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		278.90	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.22	(357)
SAP value	82.98	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2845.93	x	0.216	=	614.72	(367)
Electrical energy for community heat distribution	27.72	x	0.519	=	14.39	(372)
Total CO2 associated with community systems					629.11	(373)
Total CO2 associated with space and water heating					629.11	(376)
Pumps and fans	77.78	x	0.519	=	40.37	(378)
Electricity for lighting	235.90	x	0.519	=	122.43	(379)
Total CO_2, kg/year				(376)..(382) =	791.90	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	15.53	(384)
EI value					88.95	
EI rating (section 14)					89	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2845.93	x	1.22	=	3472.04	(367)
Electrical energy for community heat distribution	27.72	x	3.07	=	85.10	(372)
Total primary energy associated with community systems					3557.14	(373)
Total primary energy associated with space and water heating					3557.14	(376)
Pumps and fans	77.78	x	3.07	=	238.77	(378)
Electricity for lighting	235.90	x	3.07	=	724.21	(379)

Primary energy kWh/year	4520.12	(383)
Dwelling primary energy rate kWh/m2/year	88.63	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Br 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Roof			51.00	x	0.12	=	6.12			(30)
Total area of external elements ∑A, m²			106.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.64 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.90 (36)
Total fabric heat loss	(33) + (36) =	45.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.60	56.47	56.34	55.67	55.53	54.86	54.86	54.73	55.13	55.53	55.80	56.07	

Average = ∑(39)1...12/12 = 55.63 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.11	1.11	1.10	1.09	1.09	1.08	1.08	1.07	1.08	1.09	1.09	1.10	

Average = ∑(40)1...12/12 = 1.09 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.90	0.78	0.60	0.43	0.31	0.35	0.56	0.83	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.21	20.40	20.64	20.86	20.97	21.00	21.00	21.00	20.98	20.83	20.49	20.17

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.99	19.99	20.00	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20.00

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.94	0.88	0.74	0.55	0.36	0.24	0.27	0.49	0.79	0.94	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.99	19.25	19.57	19.87	19.98	20.02	20.02	20.02	20.01	19.84	19.39	18.94

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.52	19.74	20.03	20.30	20.41	20.44	20.44	20.44	20.43	20.27	19.87	19.47

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.52	19.74	20.03	20.30	20.41	20.44	20.44	20.44	20.43	20.27	19.87	19.47

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.97	0.94	0.88	0.75	0.57	0.39	0.27	0.31	0.52	0.80	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	515.95	575.44	605.17	576.59	471.00	319.00	210.67	221.01	343.19	469.69	493.09	493.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	861.29	838.26	762.33	634.36	483.55	320.38	210.82	221.30	348.83	537.09	712.28	856.18	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	256.93	176.61	116.93	41.60	9.33	0.00	0.00	0.00	0.00	50.15	157.82	270.16	

∑(98)1...5, 10...12 = 1079.53 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.17 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1079.53		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	226.70	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	906.80	(307b)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	327.69	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1310.75	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.72	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	77.78	(330a)
Total electricity for the above, kWh/year	77.78	(331)
Electricity for lighting (Appendix L)	235.90	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3085.61	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	226.70	x	2.97	x 0.01 =	6.73	(340a)
Space heating from boilers	906.80	x	4.24	x 0.01 =	38.45	(340b)
Water heating from CHP	327.69	x	2.97	x 0.01 =	9.73	(342a)
Water heating from boilers	1310.75	x	4.24	x 0.01 =	55.58	(342b)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		271.86	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.41	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	419.4742	x	0.2160	=	90.6064	(363)
less credit emissions for electricity		-139.0804	x	0.5190	=	-72.1827	(364)
Water heated by CHP		606.3326	x	0.2160	=	130.9678	(365)
less credit emissions for electricity		-201.0350	x	0.5190	=	-104.3372	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2276.75	x	0.216	=	491.78	(368)
Electrical energy for community heat distribution		27.72	x	0.519	=	14.39	(372)
Total CO2 associated with community systems						551.22	(373)
Total CO2 associated with space and water heating						551.22	(376)
Pumps and fans		77.78	x	0.519	=	40.37	(378)
Electricity for lighting		235.90	x	0.519	=	122.43	(379)
Total CO_2, kg/year					(376)..(382) =	714.01	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	14.00	(384)
EI value						90.03	

EI rating (section 14)	90	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	419.47	x	1.22	=	511.76	(363)
less credit energy for electricity		-139.08	x	3.07	=	-426.98	(364)
Water heated by CHP		606.33	x	1.22	=	739.73	(365)
less credit energy for electricity		-201.03	x	3.07	=	-617.18	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2276.75	x	1.22	=	2777.63	(368)
Electrical energy for community heat distribution		27.72	x	3.07	=	85.10	(372)
Total primary energy associated with community systems						3070.06	(373)
Total primary energy associated with space and water heating						3070.06	(376)
Pumps and fans		77.78	x	3.07	=	238.77	(378)
Electricity for lighting		235.90	x	3.07	=	724.21	(379)
Primary energy kWh/year						4033.04	(383)
Dwelling primary energy rate kWh/m2/year						79.08	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Br 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.06	x	1.24	=	17.37			(27)
External wall			40.94	x	0.15	=	6.14			(29a)
Party wall			27.50	x	0.00	=	0.00			(32)
Roof			51.00	x	0.12	=	6.12			(30)
Total area of external elements ∑A, m²			106.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.64 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.90 (36)
Total fabric heat loss	(33) + (36) =	45.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
11.07	10.93	10.80	10.13	10.00	9.32	9.32	9.19	9.59	10.00	10.26	10.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.60	56.47	56.34	55.67	55.53	54.86	54.86	54.73	55.13	55.53	55.80	56.07	

Average = ∑(39)1...12/12 = 55.63 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.11	1.11	1.10	1.09	1.09	1.08	1.08	1.07	1.08	1.09	1.09	1.10	

Average = ∑(40)1...12/12 = 1.09 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N: 1.72 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 75.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel: 1.00 (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.29 (48)

Temperature factor from Table 2b: 1.00 (49)

Energy lost from water storage (kWh/day) (48) x (49): 0.29 (50)

Enter (50) or (54) in (55): 0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

154.66	136.19	142.73	127.53	124.67	110.96	106.15	117.05	117.03	132.26	140.38	150.80	

∑(64)1...12 = 1560.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.50	58.90	62.54	56.99	56.53	51.49	50.37	54.00	53.50	59.05	61.27	65.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.39	29.66	24.12	18.26	13.65	11.52	12.45	16.19	21.73	27.58	32.20	34.32	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	89.39	87.65	84.05	79.16	75.98	71.51	67.71	72.58	74.31	79.37	85.09	87.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	427.84	424.69	409.70	386.50	363.00	341.63	328.89	335.17	348.29	371.66	397.71	417.17	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	7.13	x	36.79	x 0.9 x	0.50	x	0.90	=	81.81	(79)
NorthWest	0.77	x	5.06	x	11.28	x 0.9 x	0.50	x	0.90	=	17.80	(81)
NorthEast	0.77	x	1.87	x	11.28	x 0.9 x	0.50	x	0.90	=	6.58	(75)

Solar gains in watts ∑(74)m...(82)m

106.19	188.99	280.09	383.11	462.03	473.17	450.16	389.07	315.42	214.67	128.67	89.93	(83)

Total gains - internal and solar (73)m + (83)m

534.03	613.68	689.80	769.61	825.03	814.79	779.04	724.24	663.71	586.34	526.38	507.10	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.90	0.78	0.60	0.43	0.31	0.35	0.56	0.83	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.21	20.40	20.64	20.86	20.97	21.00	21.00	21.00	20.98	20.83	20.49	20.17

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

19.99	19.99	20.00	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20.00

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.94	0.88	0.74	0.55	0.36	0.24	0.27	0.49	0.79	0.94	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.99	19.25	19.57	19.87	19.98	20.02	20.02	20.02	20.01	19.84	19.39	18.94

(90)

Living area fraction — Living area ÷ (4) = 0.43 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.52	19.74	20.03	20.30	20.41	20.44	20.44	20.44	20.43	20.27	19.87	19.47

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.52	19.74	20.03	20.30	20.41	20.44	20.44	20.44	20.43	20.27	19.87	19.47

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.97	0.94	0.88	0.75	0.57	0.39	0.27	0.31	0.52	0.80	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	515.95	575.44	605.17	576.59	471.00	319.00	210.67	221.01	343.19	469.69	493.09	493.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	861.29	838.26	762.33	634.36	483.55	320.38	210.82	221.30	348.83	537.09	712.28	856.18	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	256.93	176.61	116.93	41.60	9.33	0.00	0.00	0.00	0.00	50.15	157.82	270.16	

∑(98)1...5, 10...12 = 1079.53 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.17 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1079.53		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	226.70	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	906.80	(307b)

Water heating

Annual water heating requirement	1560.41		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	327.69	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1310.75	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.72	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	77.78		(330a)
Total electricity for the above, kWh/year		77.78	(331)
Electricity for lighting (Appendix L)		235.90	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2852.44	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	226.70	x	2.97	x 0.01 =	6.73	(340a)
Space heating from boilers	906.80	x	4.24	x 0.01 =	38.45	(340b)
Water heating from CHP	327.69	x	2.97	x 0.01 =	9.73	(342a)
Water heating from boilers	1310.75	x	4.24	x 0.01 =	55.58	(342b)
Pumps and fans	77.78	x	13.19	x 0.01 =	10.26	(349)
Electricity for lighting	235.90	x	13.19	x 0.01 =	31.11	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		271.86	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.41	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	419.4742	x	0.2160	=	90.6064	(363)
less credit emissions for electricity		-139.0804	x	0.5190	=	-72.1827	(364)
Water heated by CHP		606.3326	x	0.2160	=	130.9678	(365)
less credit emissions for electricity		-201.0350	x	0.5190	=	-104.3372	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2276.75	x	0.216	=	491.78	(368)
Electrical energy for community heat distribution		27.72	x	0.519	=	14.39	(372)
Total CO2 associated with community systems						551.22	(373)
Total CO2 associated with space and water heating						551.22	(376)
Pumps and fans		77.78	x	0.519	=	40.37	(378)

Electricity for lighting	235.90	x	0.519	=	122.43	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	593.00	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.63	(384)
EI value					91.72	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	419.47	x	1.22	=	511.76	(363)
less credit energy for electricity		-139.08	x	3.07	=	-426.98	(364)
Water heated by CHP		606.33	x	1.22	=	739.73	(365)
less credit energy for electricity		-201.03	x	3.07	=	-617.18	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2276.75	x	1.22	=	2777.63	(368)
Electrical energy for community heat distribution		27.72	x	3.07	=	85.10	(372)
Total primary energy associated with community systems						3070.06	(373)
Total primary energy associated with space and water heating						3070.06	(376)
Pumps and fans		77.78	x	3.07	=	238.77	(378)
Electricity for lighting		235.90	x	3.07	=	724.21	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3317.18	(383)
Dwelling primary energy rate kWh/m2/year						65.04	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Cf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
Exposed floor			50.00	x	0.20	=	10.00			(28b
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			73.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.06 (36)
Total fabric heat loss	(33) + (36) =	35.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.02	45.89	45.76	45.10	44.97	44.31	44.31	44.18	44.57	44.97	45.23	45.49	

Average = ∑(39)1...12/12 = 45.07 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.92	0.92	0.92	0.90	0.90	0.89	0.89	0.88	0.89	0.90	0.90	0.91	

Average = ∑(40)1...12/12 = 0.90 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.97	0.94	0.83	0.64	0.45	0.32	0.37	0.61	0.87	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.37	20.48	20.67	20.88	20.98	21.00	21.00	21.00	20.99	20.86	20.59	20.35	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.15	20.15	20.15	20.17	20.17	20.18	20.18	20.18	20.17	20.17	20.16	20.16	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.96	0.92	0.79	0.59	0.39	0.26	0.30	0.54	0.84	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.34	19.49	19.76	20.04	20.15	20.18	20.18	20.18	20.17	20.02	19.66	19.31	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.82	19.95	20.18	20.43	20.53	20.56	20.56	20.56	20.55	20.41	20.09	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.82	19.95	20.18	20.43	20.53	20.56	20.56	20.56	20.55	20.41	20.09	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.96	0.92	0.80	0.61	0.42	0.29	0.33	0.57	0.85	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	444.69	469.20	486.81	471.27	388.58	263.34	175.40	183.69	283.20	383.81	414.98	430.10	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	714.05	690.67	625.98	519.99	397.20	264.02	175.46	183.82	287.38	441.04	587.57	709.35	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	200.41	148.83	103.54	35.08	6.42	0.00	0.00	0.00	0.00	42.58	124.27	207.76	

∑(98)1...5, 10...12 = 868.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.38 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	868.88		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	912.32	(307a)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1626.87	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.39	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)

Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2847.25	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	912.32	x	4.24	x 0.01 =	38.68	(340a)
Water heating from boilers	1626.87	x	4.24	x 0.01 =	68.98	(342a)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		268.29	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.45	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2606.97	x	0.216	=	563.11	(367)
Electrical energy for community heat distribution	25.39	x	0.519	=	13.18	(372)
Total CO2 associated with community systems					576.28	(373)
Total CO2 associated with space and water heating					576.28	(376)
Pumps and fans	76.25	x	0.519	=	39.57	(378)
Electricity for lighting	231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year				(376)..(382) =	736.17	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	14.72	(384)
EI value					89.62	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2606.97	x	1.22	=	3180.51	(367)
Electrical energy for community heat distribution	25.39	x	3.07	=	77.95	(372)
Total primary energy associated with community systems					3258.46	(373)
Total primary energy associated with space and water heating					3258.46	(376)
Pumps and fans	76.25	x	3.07	=	234.09	(378)
Electricity for lighting	231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year					4204.20	(383)
Dwelling primary energy rate kWh/m2/year					84.08	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Cf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
Exposed floor			50.00	x	0.20	=	10.00			(28b
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			73.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.06 (36)
Total fabric heat loss	(33) + (36) =	35.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.02	45.89	45.76	45.10	44.97	44.31	44.31	44.18	44.57	44.97	45.23	45.49	

Average = ∑(39)1...12/12 = 45.07 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.92	0.92	0.92	0.90	0.90	0.89	0.89	0.88	0.89	0.90	0.90	0.91	

Average = ∑(40)1...12/12 = 0.90 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.97	0.94	0.83	0.64	0.45	0.32	0.37	0.61	0.87	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.37	20.48	20.67	20.88	20.98	21.00	21.00	21.00	20.99	20.86	20.59	20.35	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.15	20.15	20.15	20.17	20.17	20.18	20.18	20.18	20.17	20.17	20.16	20.16	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.96	0.92	0.79	0.59	0.39	0.26	0.30	0.54	0.84	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.34	19.49	19.76	20.04	20.15	20.18	20.18	20.18	20.17	20.02	19.66	19.31	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.82	19.95	20.18	20.43	20.53	20.56	20.56	20.56	20.55	20.41	20.09	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.82	19.95	20.18	20.43	20.53	20.56	20.56	20.56	20.55	20.41	20.09	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.96	0.92	0.80	0.61	0.42	0.29	0.33	0.57	0.85	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	444.69	469.20	486.81	471.27	388.58	263.34	175.40	183.69	283.20	383.81	414.98	430.10	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	714.05	690.67	625.98	519.99	397.20	264.02	175.46	183.82	287.38	441.04	587.57	709.35	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	200.41	148.83	103.54	35.08	6.42	0.00	0.00	0.00	0.00	42.58	124.27	207.76	

∑(98)1...5, 10...12 = 868.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.38 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	868.88		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	182.46	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	729.86	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.39	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2847.25	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	182.46	x	2.97	x 0.01 =	5.42	(340a)
Space heating from boilers	729.86	x	4.24	x 0.01 =	30.95	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		261.85	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.16	(357)
SAP value	83.85	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	337.6207	x	0.2160	=	72.9261	(363)
less credit emissions for electricity		-111.9412	x	0.5190	=	-58.0975	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2085.58	x	0.216	=	450.49	(368)
Electrical energy for community heat distribution		25.39	x	0.519	=	13.18	(372)
Total CO2 associated with community systems						504.93	(373)
Total CO2 associated with space and water heating						504.93	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year					(376)..(382) =	664.82	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	13.30	(384)
EI value						90.62	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	337.62	x	1.22	=	411.90	(363)
less credit energy for electricity		-111.94	x	3.07	=	-343.66	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2085.58	x	1.22	=	2544.41	(368)
Electrical energy for community heat distribution		25.39	x	3.07	=	77.95	(372)
Total primary energy associated with community systems						2812.28	(373)
Total primary energy associated with space and water heating						2812.28	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year						3758.02	(383)
Dwelling primary energy rate kWh/m2/year						75.16	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Cf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
Exposed floor			50.00	x	0.20	=	10.00			(28b
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			73.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.06 (36)
Total fabric heat loss	(33) + (36) =	35.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.02	45.89	45.76	45.10	44.97	44.31	44.31	44.18	44.57	44.97	45.23	45.49	

Average = ∑(39)1...12/12 = 45.07 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.92	0.92	0.92	0.90	0.90	0.89	0.89	0.88	0.89	0.90	0.90	0.91	

Average = ∑(40)1...12/12 = 0.90 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.97	0.94	0.83	0.64	0.45	0.32	0.37	0.61	0.87	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.37	20.48	20.67	20.88	20.98	21.00	21.00	21.00	20.99	20.86	20.59	20.35	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.15	20.15	20.15	20.17	20.17	20.18	20.18	20.18	20.17	20.17	20.16	20.16	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.96	0.92	0.79	0.59	0.39	0.26	0.30	0.54	0.84	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.34	19.49	19.76	20.04	20.15	20.18	20.18	20.18	20.17	20.02	19.66	19.31	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.82	19.95	20.18	20.43	20.53	20.56	20.56	20.56	20.55	20.41	20.09	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.82	19.95	20.18	20.43	20.53	20.56	20.56	20.56	20.55	20.41	20.09	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.96	0.92	0.80	0.61	0.42	0.29	0.33	0.57	0.85	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	444.69	469.20	486.81	471.27	388.58	263.34	175.40	183.69	283.20	383.81	414.98	430.10	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	714.05	690.67	625.98	519.99	397.20	264.02	175.46	183.82	287.38	441.04	587.57	709.35	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	200.41	148.83	103.54	35.08	6.42	0.00	0.00	0.00	0.00	42.58	124.27	207.76	

∑(98)1...5, 10...12 = 868.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.38 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	868.88		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	182.46	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	729.86	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.39	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2614.07	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	182.46	x	2.97	x 0.01 =	5.42	(340a)
Space heating from boilers	729.86	x	4.24	x 0.01 =	30.95	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		261.85	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.16	(357)
SAP value	83.85	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	337.6207	x	0.2160	=	72.9261	(363)
less credit emissions for electricity		-111.9412	x	0.5190	=	-58.0975	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2085.58	x	0.216	=	450.49	(368)
Electrical energy for community heat distribution		25.39	x	0.519	=	13.18	(372)
Total CO2 associated with community systems						504.93	(373)
Total CO2 associated with space and water heating						504.93	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Energy saving/generation technologies							

pv savings		-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year					(376)..(382) =	543.80	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.88	(384)
EI value						92.33	
EI rating (section 14)						92	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	337.62	x	1.22	=	411.90	(363)
less credit energy for electricity		-111.94	x	3.07	=	-343.66	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2085.58	x	1.22	=	2544.41	(368)
Electrical energy for community heat distribution		25.39	x	3.07	=	77.95	(372)
Total primary energy associated with community systems						2812.28	(373)
Total primary energy associated with space and water heating						2812.28	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3042.17	(383)
Dwelling primary energy rate kWh/m2/year						60.84	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Co 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			23.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	14.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		3.56 (36)
Total fabric heat loss	(33) + (36) =	17.67 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

28.52	28.39	28.26	27.60	27.47	26.81	26.81	26.68	27.07	27.47	27.73	27.99	

Average = ∑(39)1...12/12 = 27.57 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	

Average = ∑(40)1...12/12 = 0.55 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.92	0.87	0.76	0.57	0.40	0.27	0.20	0.22	0.38	0.63	0.84	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.88	20.93	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.96	20.87	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.46	20.46	20.46	20.47	20.48	20.49	20.49	20.49	20.48	20.48	20.47	20.47	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.85	0.73	0.54	0.38	0.25	0.17	0.20	0.35	0.60	0.82	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.31	20.38	20.44	20.47	20.48	20.49	20.49	20.49	20.48	20.47	20.42	20.31	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.57	20.63	20.69	20.72	20.72	20.73	20.73	20.73	20.72	20.72	20.67	20.57	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.57	20.63	20.69	20.72	20.72	20.73	20.73	20.73	20.72	20.72	20.67	20.57	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.86	0.74	0.55	0.39	0.26	0.18	0.21	0.36	0.61	0.83	0.92	(94)
Useful gains, ηmGm, W (94)m x (84)m	414.59	418.45	392.94	325.53	247.70	164.22	110.60	115.43	179.29	276.76	359.58	404.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	464.14	446.68	400.96	326.11	247.72	164.22	110.60	115.43	179.30	277.86	376.36	458.19	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	36.87	18.97	5.97	0.42	0.02	0.00	0.00	0.00	0.00	0.82	12.08	39.97	

∑(98)1...5, 10...12 = 115.11 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.30 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		1.00 (303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	115.11	(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	120.86 (307a)

Water heating

Annual water heating requirement	1549.40	(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1626.87 (310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	17.48 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	76.25	(330a)
Total electricity for the above, kWh/year		76.25 (331)
Electricity for lighting (Appendix L)		231.81 (332)

Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2055.79	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	120.86	x	4.24	x 0.01 =	5.12	(340a)
Water heating from boilers	1626.87	x	4.24	x 0.01 =	68.98	(342a)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		234.74	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.52	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1794.39	x	0.216	=	387.59	(367)
Electrical energy for community heat distribution	17.48	x	0.519	=	9.07	(372)
Total CO2 associated with community systems					396.66	(373)
Total CO2 associated with space and water heating					396.66	(376)
Pumps and fans	76.25	x	0.519	=	39.57	(378)
Electricity for lighting	231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year				(376)..(382) =	556.54	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.13	(384)
EI value					92.15	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1794.39	x	1.22	=	2189.15	(367)
Electrical energy for community heat distribution	17.48	x	3.07	=	53.66	(372)
Total primary energy associated with community systems					2242.81	(373)
Total primary energy associated with space and water heating					2242.81	(376)
Pumps and fans	76.25	x	3.07	=	234.09	(378)
Electricity for lighting	231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year					3188.55	(383)
Dwelling primary energy rate kWh/m2/year					63.77	(384)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Co 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			23.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	14.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		3.56 (36)
Total fabric heat loss	(33) + (36) =	17.67 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

28.52	28.39	28.26	27.60	27.47	26.81	26.81	26.68	27.07	27.47	27.73	27.99	

Average = ∑(39)1...12/12 = 27.57 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	

Average = ∑(40)1...12/12 = 0.55 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.92	0.87	0.76	0.57	0.40	0.27	0.20	0.22	0.38	0.63	0.84	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.88	20.93	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.96	20.87	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.46	20.46	20.46	20.47	20.48	20.49	20.49	20.49	20.48	20.48	20.47	20.47	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.85	0.73	0.54	0.38	0.25	0.17	0.20	0.35	0.60	0.82	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.31	20.38	20.44	20.47	20.48	20.49	20.49	20.49	20.48	20.47	20.42	20.31	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.57	20.63	20.69	20.72	20.72	20.73	20.73	20.73	20.72	20.72	20.67	20.57	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.57	20.63	20.69	20.72	20.72	20.73	20.73	20.73	20.72	20.72	20.67	20.57	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.86	0.74	0.55	0.39	0.26	0.18	0.21	0.36	0.61	0.83	0.92	(94)
Useful gains, ηmGm, W (94)m x (84)m	414.59	418.45	392.94	325.53	247.70	164.22	110.60	115.43	179.29	276.76	359.58	404.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	464.14	446.68	400.96	326.11	247.72	164.22	110.60	115.43	179.30	277.86	376.36	458.19	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	36.87	18.97	5.97	0.42	0.02	0.00	0.00	0.00	0.00	0.82	12.08	39.97	

∑(98)1...5, 10...12 = 115.11 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.30 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		0.80 (303a)
Fraction of community heat from CHP		0.20 (303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20 (304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	115.11		(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	24.17 (307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	96.69 (307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	325.37 (310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) =	1301.50 (310b)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	17.48 (313)

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Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2055.79	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	24.17	x	2.97	x 0.01 =	0.72	(340a)
Space heating from boilers	96.69	x	4.24	x 0.01 =	4.10	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		230.30	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.02	(357)
SAP value	85.80	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	44.7273	x	0.2160	=	9.6611	(363)
less credit emissions for electricity		-14.8297	x	0.5190	=	-7.6966	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1435.51	x	0.216	=	310.07	(368)
Electrical energy for community heat distribution		17.48	x	0.519	=	9.07	(372)
Total CO2 associated with community systems						347.55	(373)
Total CO2 associated with space and water heating						347.55	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year					(376)..(382) =	507.43	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.15	(384)
EI value						92.84	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	44.73	x	1.22	=	54.57	(363)
less credit energy for electricity		-14.83	x	3.07	=	-45.53	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1435.51	x	1.22	=	1751.32	(368)
Electrical energy for community heat distribution		17.48	x	3.07	=	53.66	(372)
Total primary energy associated with community systems						1935.70	(373)
Total primary energy associated with space and water heating						1935.70	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year						2881.44	(383)
Dwelling primary energy rate kWh/m2/year						57.63	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Co 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			23.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	14.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		3.56 (36)
Total fabric heat loss	(33) + (36) =	17.67 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

28.52	28.39	28.26	27.60	27.47	26.81	26.81	26.68	27.07	27.47	27.73	27.99	

Average = ∑(39)1...12/12 = 27.57 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	

Average = ∑(40)1...12/12 = 0.55 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.92	0.87	0.76	0.57	0.40	0.27	0.20	0.22	0.38	0.63	0.84	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.88	20.93	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.96	20.87	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.46	20.46	20.46	20.47	20.48	20.49	20.49	20.49	20.48	20.48	20.47	20.47	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.85	0.73	0.54	0.38	0.25	0.17	0.20	0.35	0.60	0.82	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.31	20.38	20.44	20.47	20.48	20.49	20.49	20.49	20.48	20.47	20.42	20.31	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.57	20.63	20.69	20.72	20.72	20.73	20.73	20.73	20.72	20.72	20.67	20.57	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.57	20.63	20.69	20.72	20.72	20.73	20.73	20.73	20.72	20.72	20.67	20.57	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.86	0.74	0.55	0.39	0.26	0.18	0.21	0.36	0.61	0.83	0.92	(94)
Useful gains, ηmGm, W (94)m x (84)m	414.59	418.45	392.94	325.53	247.70	164.22	110.60	115.43	179.29	276.76	359.58	404.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	464.14	446.68	400.96	326.11	247.72	164.22	110.60	115.43	179.30	277.86	376.36	458.19	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	36.87	18.97	5.97	0.42	0.02	0.00	0.00	0.00	0.00	0.82	12.08	39.97	

∑(98)1...5, 10...12 = 115.11 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.30 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		0.80 (303a)
Fraction of community heat from CHP		0.20 (303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20 (304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	115.11		(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	24.17 (307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	96.69 (307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	325.37 (310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) =	1301.50 (310b)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	17.48 (313)

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Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	1822.62	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	24.17	x	2.97	x 0.01 =	0.72	(340a)
Space heating from boilers	96.69	x	4.24	x 0.01 =	4.10	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		230.30	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.02	(357)
SAP value	85.80	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	44.7273	x	0.2160	=	9.6611	(363)
less credit emissions for electricity		-14.8297	x	0.5190	=	-7.6966	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1435.51	x	0.216	=	310.07	(368)
Electrical energy for community heat distribution		17.48	x	0.519	=	9.07	(372)
Total CO2 associated with community systems						347.55	(373)
Total CO2 associated with space and water heating						347.55	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Energy saving/generation technologies							
pv savings		-233.18	x	0.519	=	-121.02	(380)

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Total CO_2, kg/year	(376)..(382) =	386.41	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	7.73	(384)
EI value		94.55	
EI rating (section 14)		95	(385)
EI band		A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	44.73	x	1.22	=	54.57	(363)
less credit energy for electricity		-14.83	x	3.07	=	-45.53	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1435.51	x	1.22	=	1751.32	(368)
Electrical energy for community heat distribution		17.48	x	3.07	=	53.66	(372)
Total primary energy associated with community systems						1935.70	(373)
Total primary energy associated with space and water heating						1935.70	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2165.59	(383)
Dwelling primary energy rate kWh/m2/year						43.31	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Cr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Roof			50.00	x	0.12	=	6.00			(30)
Total area of external elements ∑A, m²			73.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.06 (36)
Total fabric heat loss	(33) + (36) =	31.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.02	41.89	41.76	41.10	40.97	40.31	40.31	40.18	40.57	40.97	41.23	41.49	

Average = ∑(39)1...12/12 = 41.07 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.80	0.81	0.82	0.82	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N: 1.69 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel: 1.00 (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.29 (48)

Temperature factor from Table 2b: 1.00 (49)

Energy lost from water storage (kWh/day) (48) x (49): 0.29 (50)

Enter (50) or (54) in (55): 0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.92	0.79	0.59	0.41	0.30	0.34	0.56	0.84	0.96	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.49	20.59	20.76	20.93	20.99	21.00	21.00	21.00	20.99	20.91	20.69	20.47	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.24	20.24	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.95	0.90	0.75	0.55	0.36	0.24	0.28	0.50	0.80	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.56	19.71	19.94	20.16	20.23	20.25	20.25	20.25	20.24	20.14	19.85	19.54	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.99	20.12	20.32	20.52	20.58	20.60	20.60	20.60	20.59	20.50	20.24	19.97	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.99	20.12	20.32	20.52	20.58	20.60	20.60	20.60	20.59	20.50	20.24	19.97	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.90	0.76	0.57	0.38	0.27	0.31	0.53	0.82	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	442.60	465.28	477.46	448.96	359.95	241.48	161.10	168.63	261.55	369.54	410.56	428.42	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	659.40	637.49	577.13	477.47	363.84	241.71	161.11	168.67	263.32	405.54	541.67	654.38	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	161.30	115.72	74.16	20.53	2.89	0.00	0.00	0.00	0.00	26.78	94.40	168.11	

∑(98)1...5, 10...12 = 663.90 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.28 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	663.90		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	697.09	(307a)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1626.87	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.24	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)

Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2632.02	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	697.09	x	4.24	x 0.01 =	29.56	(340a)
Water heating from boilers	1626.87	x	4.24	x 0.01 =	68.98	(342a)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		259.17	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.15	(357)
SAP value	84.02	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2386.00	x	0.216	=	515.38	(367)
Electrical energy for community heat distribution	23.24	x	0.519	=	12.06	(372)
Total CO2 associated with community systems					527.44	(373)
Total CO2 associated with space and water heating					527.44	(376)
Pumps and fans	76.25	x	0.519	=	39.57	(378)
Electricity for lighting	231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year				(376)..(382) =	687.32	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.75	(384)
EI value					90.31	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2386.00	x	1.22	=	2910.92	(367)
Electrical energy for community heat distribution	23.24	x	3.07	=	71.35	(372)
Total primary energy associated with community systems					2982.26	(373)
Total primary energy associated with space and water heating					2982.26	(376)
Pumps and fans	76.25	x	3.07	=	234.09	(378)
Electricity for lighting	231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year					3928.01	(383)
Dwelling primary energy rate kWh/m2/year					78.56	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Cr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Roof			50.00	x	0.12	=	6.00			(30)
Total area of external elements ∑A, m²			73.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.06 (36)
Total fabric heat loss	(33) + (36) =	31.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.02	41.89	41.76	41.10	40.97	40.31	40.31	40.18	40.57	40.97	41.23	41.49	

Average = ∑(39)1...12/12 = 41.07 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.80	0.81	0.82	0.82	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.92	0.79	0.59	0.41	0.30	0.34	0.56	0.84	0.96	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.49	20.59	20.76	20.93	20.99	21.00	21.00	21.00	20.99	20.91	20.69	20.47	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.24	20.24	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.95	0.90	0.75	0.55	0.36	0.24	0.28	0.50	0.80	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.56	19.71	19.94	20.16	20.23	20.25	20.25	20.25	20.24	20.14	19.85	19.54	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.99	20.12	20.32	20.52	20.58	20.60	20.60	20.60	20.59	20.50	20.24	19.97	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.99	20.12	20.32	20.52	20.58	20.60	20.60	20.60	20.59	20.50	20.24	19.97	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.90	0.76	0.57	0.38	0.27	0.31	0.53	0.82	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	442.60	465.28	477.46	448.96	359.95	241.48	161.10	168.63	261.55	369.54	410.56	428.42	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	659.40	637.49	577.13	477.47	363.84	241.71	161.11	168.67	263.32	405.54	541.67	654.38	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	161.30	115.72	74.16	20.53	2.89	0.00	0.00	0.00	0.00	26.78	94.40	168.11	

∑(98)1...5, 10...12 = 663.90 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.28 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	663.90		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	139.42	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	557.67	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.24	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2632.02	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	139.42	x	2.97	x 0.01 =	4.14	(340a)
Space heating from boilers	557.67	x	4.24	x 0.01 =	23.65	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		253.27	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.12	(357)
SAP value	84.38	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	257.9710	x	0.2160	=	55.7217	(363)
less credit emissions for electricity		-85.5326	x	0.5190	=	-44.3914	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1908.80	x	0.216	=	412.30	(368)
Electrical energy for community heat distribution		23.24	x	0.519	=	12.06	(372)
Total CO2 associated with community systems						462.14	(373)
Total CO2 associated with space and water heating						462.14	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year					(376)..(382) =	622.02	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.44	(384)
EI value						91.23	
EI rating (section 14)						91	(385)
EI band						B	

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13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	257.97	x	1.22	=	314.72	(363)
less credit energy for electricity		-85.53	x	3.07	=	-262.59	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1908.80	x	1.22	=	2328.73	(368)
Electrical energy for community heat distribution		23.24	x	3.07	=	71.35	(372)
Total primary energy associated with community systems						2573.90	(373)
Total primary energy associated with space and water heating						2573.90	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year						3519.65	(383)
Dwelling primary energy rate kWh/m2/year						70.39	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Cr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.71	x	1.24	=	12.00			(27)
External wall			14.04	x	0.15	=	2.11			(29a)
Party wall			51.25	x	0.00	=	0.00			(32)
Roof			50.00	x	0.12	=	6.00			(30)
Total area of external elements ∑A, m²			73.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.11 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.06 (36)
Total fabric heat loss	(33) + (36) =	31.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.02	41.89	41.76	41.10	40.97	40.31	40.31	40.18	40.57	40.97	41.23	41.49	

Average = ∑(39)1...12/12 = 41.07 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.80	0.81	0.82	0.82	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	9.71	x	11.28	x 0.9 x	0.50	x	0.90	=	34.17	(81)

Solar gains in watts ∑(74)m...(82)m

34.17	69.54	125.30	205.77	276.60	294.89	275.86	219.92	152.68	84.99	42.99	27.90	(83)

Total gains - internal and solar (73)m + (83)m

456.24	488.51	529.51	587.15	634.86	632.11	600.53	550.80	496.46	451.79	435.43	439.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.92	0.79	0.59	0.41	0.30	0.34	0.56	0.84	0.96	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.49	20.59	20.76	20.93	20.99	21.00	21.00	21.00	20.99	20.91	20.69	20.47	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.25	20.24	20.24	20.23	20.23	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.95	0.90	0.75	0.55	0.36	0.24	0.28	0.50	0.80	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.56	19.71	19.94	20.16	20.23	20.25	20.25	20.25	20.24	20.14	19.85	19.54	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.99	20.12	20.32	20.52	20.58	20.60	20.60	20.60	20.59	20.50	20.24	19.97	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.99	20.12	20.32	20.52	20.58	20.60	20.60	20.60	20.59	20.50	20.24	19.97	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.90	0.76	0.57	0.38	0.27	0.31	0.53	0.82	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	442.60	465.28	477.46	448.96	359.95	241.48	161.10	168.63	261.55	369.54	410.56	428.42	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	659.40	637.49	577.13	477.47	363.84	241.71	161.11	168.67	263.32	405.54	541.67	654.38	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	161.30	115.72	74.16	20.53	2.89	0.00	0.00	0.00	0.00	26.78	94.40	168.11	

∑(98)1...5, 10...12 = 663.90 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.28 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	663.90		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	139.42	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	557.67	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.24	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2398.84	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	139.42	x	2.97	x 0.01 =	4.14	(340a)
Space heating from boilers	557.67	x	4.24	x 0.01 =	23.65	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		253.27	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.12	(357)
SAP value	84.38	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	257.9710	x	0.2160	=	55.7217	(363)
less credit emissions for electricity		-85.5326	x	0.5190	=	-44.3914	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1908.80	x	0.216	=	412.30	(368)
Electrical energy for community heat distribution		23.24	x	0.519	=	12.06	(372)
Total CO2 associated with community systems						462.14	(373)
Total CO2 associated with space and water heating						462.14	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	501.00	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.02	(384)
EI value					92.93	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	257.97	x	1.22	=	314.72	(363)
less credit energy for electricity		-85.53	x	3.07	=	-262.59	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1908.80	x	1.22	=	2328.73	(368)
Electrical energy for community heat distribution		23.24	x	3.07	=	71.35	(372)
Total primary energy associated with community systems						2573.90	(373)
Total primary energy associated with space and water heating						2573.90	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2803.79	(383)
Dwelling primary energy rate kWh/m2/year						56.08	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Df 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.00	(1a) x	2.50	(2a) =	182.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.63	x	1.24	=	21.79			(27)
Exposed floor			73.00	x	0.19	=	13.80			(28b
External wall			13.62	x	0.15	=	2.04			(29a)
Party wall			75.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			104.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.63 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.64 (36)
Total fabric heat loss	(33) + (36) =	53.26 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)

Heat transfer coefficient, W/K (37)m + (38)m

69.11	68.91	68.72	67.76	67.57	66.61	66.61	66.42	66.99	67.57	67.95	68.34	

Average = ∑(39)1...12/12 = 67.71 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.95	0.94	0.94	0.93	0.93	0.91	0.91	0.91	0.92	0.93	0.93	0.94	

Average = ∑(40)1...12/12 = 0.93 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.32	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.22	(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.14	94.57	91.01	87.44	83.87	80.30	80.30	83.87	87.44	91.01	94.57	98.14	

∑(44)1...12 = 1070.66 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.54	127.29	131.36	114.52	109.88	94.82	87.87	100.83	102.03	118.91	129.80	140.95	

∑(45)1...12 = 1403.80 (45)

Distribution loss 0.15 x (45)m

21.83	19.09	19.70	17.18	16.48	14.22	13.18	15.12	15.30	17.84	19.47	21.14	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.29	(48)
Temperature factor from Table 2b	1.00	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29	(50)
Enter (50) or (54) in (55)	0.29	(55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	

∑(64)1...12 = 1783.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.20	65.63	69.48	63.05	62.34	56.50	55.02	59.33	58.90	65.34	68.13	72.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.51	40.42	32.87	24.89	18.60	15.71	16.97	22.06	29.61	37.59	43.88	46.78	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.77	307.93	299.96	283.00	261.58	241.45	228.00	224.84	232.81	249.78	271.19	291.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	(71)
Water heating gains (Table 5)	99.73	97.66	93.38	87.57	83.79	78.47	73.95	79.74	81.80	87.82	94.62	97.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	547.56	543.57	523.77	493.00	461.52	433.18	416.47	424.19	441.77	472.74	507.24	533.32	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	17.63	x	36.79	x 0.9 x	0.50	x	0.90	=	202.29	(79)

Solar gains in watts ∑(74)m...(82)m

202.29	344.57	471.46	584.16	654.31	649.58	626.26	573.93	510.49	380.83	242.30	173.12	(83)

Total gains - internal and solar (73)m + (83)m

749.84	888.14	995.23	1077.16	1115.83	1082.76	1042.74	998.12	952.26	853.57	749.54	706.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.93	0.86	0.72	0.56	0.39	0.28	0.31	0.48	0.76	0.94	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.43	20.62	20.81	20.94	20.99	21.00	21.00	21.00	21.00	20.93	20.67	20.39	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.13	20.13	20.13	20.14	20.15	20.16	20.16	20.16	20.15	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.83	0.68	0.51	0.34	0.23	0.25	0.42	0.72	0.92	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.40	19.67	19.91	20.08	20.14	20.16	20.16	20.16	20.15	20.08	19.75	19.35	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.80	20.04	20.26	20.41	20.47	20.48	20.48	20.48	20.48	20.41	20.11	19.75	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.80	20.04	20.26	20.41	20.47	20.48	20.48	20.48	20.48	20.41	20.11	19.75	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.91	0.83	0.69	0.53	0.36	0.25	0.27	0.45	0.73	0.92	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	719.73	812.03	828.64	745.38	585.98	391.26	258.58	271.17	425.34	623.62	687.28	684.23	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1071.07	1043.17	945.47	780.22	592.26	391.79	258.62	271.24	427.20	662.71	883.96	1062.63	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	261.40	155.33	86.92	25.09	4.67	0.00	0.00	0.00	0.00	29.08	141.61	281.53	

∑(98)1...5, 10...12 = 985.62 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.50 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11) — '0' if none = 0.00 (301)

Fraction of space heat from community system — 1 - (301) = 1.00 (302)

Fraction of community heat from boilers — 1.00 (303a)

Fraction of total space heat from community boilers — (302) x (303a) = 1.00 (304a)

Factor for control and charging method (Table 4c(3)) for community space heating — 1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating — 1.00 (305a)

Distribution loss factor (Table 12c) for community heating system — 1.05 (306)

Space heating

Annual space heating requirement — 985.62 (98)

Space heat from boilers — (98) x (304a) x (305) x (306) = 1034.90 (307a)

Water heating

Annual water heating requirement — 1783.55 (64)

Water heat from boilers — (64) x (303a) x (305a) x (306) = 1872.73 (310a)

Electricity used for heat distribution — 0.01 × [(307a)...(307e) + (310a)...(310e)] = 29.08 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside — 119.67 (330a)

Total electricity for the above, kWh/year — 119.67 (331)

Electricity for lighting (Appendix L)		321.49	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3348.80	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1034.90	x	4.24	x 0.01 =	43.88	(340a)
Water heating from boilers	1872.73	x	4.24	x 0.01 =	79.40	(342a)
Pumps and fans	119.67	x	13.19	x 0.01 =	15.79	(349)
Electricity for lighting	321.49	x	13.19	x 0.01 =	42.40	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		301.47	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.03	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2985.25	x	0.216	=	644.81	(367)
Electrical energy for community heat distribution	29.08	x	0.519	=	15.09	(372)
Total CO2 associated with community systems					659.90	(373)
Total CO2 associated with space and water heating					659.90	(376)
Pumps and fans	119.67	x	0.519	=	62.11	(378)
Electricity for lighting	321.49	x	0.519	=	166.85	(379)
Total CO_2, kg/year				(376)..(382) =	888.87	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.18	(384)
EI value					89.91	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2985.25	x	1.22	=	3642.00	(367)
Electrical energy for community heat distribution	29.08	x	3.07	=	89.26	(372)
Total primary energy associated with community systems					3731.27	(373)
Total primary energy associated with space and water heating					3731.27	(376)
Pumps and fans	119.67	x	3.07	=	367.40	(378)
Electricity for lighting	321.49	x	3.07	=	986.98	(379)
Primary energy kWh/year					5085.64	(383)
Dwelling primary energy rate kWh/m2/year					69.67	(384)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Df 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.00	(1a) x	2.50	(2a) =	182.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.63	x	1.24	=	21.79			(27)
Exposed floor			73.00	x	0.19	=	13.80			(28b
External wall			13.62	x	0.15	=	2.04			(29a)
Party wall			75.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			104.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.63 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.64 (36)
Total fabric heat loss	(33) + (36) =	53.26 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)

Heat transfer coefficient, W/K (37)m + (38)m

69.11	68.91	68.72	67.76	67.57	66.61	66.61	66.42	66.99	67.57	67.95	68.34	

Average = ∑(39)1...12/12 = 67.71 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.95	0.94	0.94	0.93	0.93	0.91	0.91	0.91	0.92	0.93	0.93	0.94	

Average = ∑(40)1...12/12 = 0.93 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.32 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		89.22 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.14	94.57	91.01	87.44	83.87	80.30	80.30	83.87	87.44	91.01	94.57	98.14	

∑(44)1...12 = 1070.66 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.54	127.29	131.36	114.52	109.88	94.82	87.87	100.83	102.03	118.91	129.80	140.95	

∑(45)1...12 = 1403.80 (45)

Distribution loss 0.15 x (45)m

21.83	19.09	19.70	17.18	16.48	14.22	13.18	15.12	15.30	17.84	19.47	21.14	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	

∑(64)1...12 = 1783.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.20	65.63	69.48	63.05	62.34	56.50	55.02	59.33	58.90	65.34	68.13	72.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.51	40.42	32.87	24.89	18.60	15.71	16.97	22.06	29.61	37.59	43.88	46.78	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.77	307.93	299.96	283.00	261.58	241.45	228.00	224.84	232.81	249.78	271.19	291.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	(71)
Water heating gains (Table 5)	99.73	97.66	93.38	87.57	83.79	78.47	73.95	79.74	81.80	87.82	94.62	97.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	547.56	543.57	523.77	493.00	461.52	433.18	416.47	424.19	441.77	472.74	507.24	533.32	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	17.63	x	36.79	x 0.9 x	0.50	x	0.90	=	202.29	(79)

Solar gains in watts ∑(74)m...(82)m

202.29	344.57	471.46	584.16	654.31	649.58	626.26	573.93	510.49	380.83	242.30	173.12	(83)

Total gains - internal and solar (73)m + (83)m

749.84	888.14	995.23	1077.16	1115.83	1082.76	1042.74	998.12	952.26	853.57	749.54	706.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.93	0.86	0.72	0.56	0.39	0.28	0.31	0.48	0.76	0.94	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.43	20.62	20.81	20.94	20.99	21.00	21.00	21.00	21.00	20.93	20.67	20.39	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.13	20.13	20.13	20.14	20.15	20.16	20.16	20.16	20.15	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.96	0.92	0.83	0.68	0.51	0.34	0.23	0.25	0.42	0.72	0.92	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.40	19.67	19.91	20.08	20.14	20.16	20.16	20.16	20.15	20.08	19.75	19.35	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.80	20.04	20.26	20.41	20.47	20.48	20.48	20.48	20.48	20.41	20.11	19.75	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.80	20.04	20.26	20.41	20.47	20.48	20.48	20.48	20.48	20.41	20.11	19.75	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.91	0.83	0.69	0.53	0.36	0.25	0.27	0.45	0.73	0.92	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	719.73	812.03	828.64	745.38	585.98	391.26	258.58	271.17	425.34	623.62	687.28	684.23	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1071.07	1043.17	945.47	780.22	592.26	391.79	258.62	271.24	427.20	662.71	883.96	1062.63	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	261.40	155.33	86.92	25.09	4.67	0.00	0.00	0.00	0.00	29.08	141.61	281.53	

∑(98)1...5, 10...12 = 985.62 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.50 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	985.62		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	206.98	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	827.92	(307b)

Water heating

Annual water heating requirement	1783.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	374.55	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1498.18	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.08	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	119.67		(330a)
Total electricity for the above, kWh/year		119.67	(331)
Electricity for lighting (Appendix L)		321.49	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3348.80	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	206.98	x	2.97	x 0.01 =	6.15	(340a)
Space heating from boilers	827.92	x	4.24	x 0.01 =	35.10	(340b)
Water heating from CHP	374.55	x	2.97	x 0.01 =	11.12	(342a)
Water heating from boilers	1498.18	x	4.24	x 0.01 =	63.52	(342b)
Pumps and fans	119.67	x	13.19	x 0.01 =	15.79	(349)
Electricity for lighting	321.49	x	13.19	x 0.01 =	42.40	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		294.09	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.40	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	382.9848	x	0.2410	=	92.2993	(363)
less credit emissions for electricity		-126.9820	x	0.5190	=	-65.9037	(364)
Water heated by CHP		693.0366	x	0.2410	=	167.0218	(365)
less credit emissions for electricity		-229.7825	x	0.5190	=	-119.2571	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2388.20	x	0.216	=	515.85	(368)
Electrical energy for community heat distribution		29.08	x	0.519	=	15.09	(372)
Total CO2 associated with community systems						605.10	(373)
Total CO2 associated with space and water heating						605.10	(376)
Pumps and fans		119.67	x	0.519	=	62.11	(378)
Electricity for lighting		321.49	x	0.519	=	166.85	(379)
Total CO_2, kg/year					(376)..(382) =	834.07	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.43	(384)
EI value						90.53	
EI rating (section 14)						91	(385)
EI band						B	

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13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	382.98	x	1.09	=	417.45	(363)
less credit energy for electricity		-126.98	x	3.07	=	-389.83	(364)
Water heated by CHP		693.04	x	1.09	=	755.41	(365)
less credit energy for electricity		-229.78	x	3.07	=	-705.43	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2388.20	x	1.22	=	2913.60	(368)
Electrical energy for community heat distribution		29.08	x	3.07	=	89.26	(372)
Total primary energy associated with community systems						3080.46	(373)
Total primary energy associated with space and water heating						3080.46	(376)
Pumps and fans		119.67	x	3.07	=	367.40	(378)
Electricity for lighting		321.49	x	3.07	=	986.98	(379)
Primary energy kWh/year						4434.84	(383)
Dwelling primary energy rate kWh/m2/year						60.75	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Do 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.00	(1a) x	2.50	(2a) =	182.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.63	x	1.24	=	21.79			(27)
External wall			13.62	x	0.15	=	2.04			(29a)
Party wall			75.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			31.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.83 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.69 (36)
Total fabric heat loss	(33) + (36) =	28.52 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)

Heat transfer coefficient, W/K (37)m + (38)m

44.36	44.17	43.98	43.02	42.82	41.86	41.86	41.67	42.25	42.82	43.21	43.59	

Average = ∑(39)1...12/12 = 42.97 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.61	0.61	0.60	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.59	0.60	

Average = ∑(40)1...12/12 = 0.59 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.32 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.22 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.14	94.57	91.01	87.44	83.87	80.30	80.30	83.87	87.44	91.01	94.57	98.14	

∑(44)1...12 = 1070.66 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.54	127.29	131.36	114.52	109.88	94.82	87.87	100.83	102.03	118.91	129.80	140.95	

∑(45)1...12 = 1403.80 (45)

Distribution loss 0.15 x (45)m

21.83	19.09	19.70	17.18	16.48	14.22	13.18	15.12	15.30	17.84	19.47	21.14	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	

∑(64)1...12 = 1783.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.20	65.63	69.48	63.05	62.34	56.50	55.02	59.33	58.90	65.34	68.13	72.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.51	40.42	32.87	24.89	18.60	15.71	16.97	22.06	29.61	37.59	43.88	46.78	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.77	307.93	299.96	283.00	261.58	241.45	228.00	224.84	232.81	249.78	271.19	291.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	(71)
Water heating gains (Table 5)	99.73	97.66	93.38	87.57	83.79	78.47	73.95	79.74	81.80	87.82	94.62	97.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	547.56	543.57	523.77	493.00	461.52	433.18	416.47	424.19	441.77	472.74	507.24	533.32	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	17.63	x	36.79	x 0.9 x	0.50	x	0.90	=	202.29	(79)

Solar gains in watts ∑(74)m...(82)m

202.29	344.57	471.46	584.16	654.31	649.58	626.26	573.93	510.49	380.83	242.30	173.12	(83)

Total gains - internal and solar (73)m + (83)m

749.84	888.14	995.23	1077.16	1115.83	1082.76	1042.74	998.12	952.26	853.57	749.54	706.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.89	0.77	0.64	0.48	0.36	0.25	0.18	0.19	0.31	0.52	0.78	0.91	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.90	20.97	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.97	20.87	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.42	20.43	20.43	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.87	0.75	0.61	0.46	0.34	0.23	0.15	0.17	0.28	0.49	0.75	0.90	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.30	20.39	20.42	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.41	20.28	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.53	20.61	20.64	20.66	20.66	20.66	20.66	20.67	20.66	20.66	20.63	20.51	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.53	20.61	20.64	20.66	20.66	20.66	20.66	20.67	20.66	20.66	20.63	20.51	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.88	0.76	0.62	0.47	0.34	0.23	0.16	0.18	0.29	0.50	0.76	0.90	(94)
Useful gains, ηmGm, W (94)m x (84)m	657.50	674.15	617.92	505.34	383.58	253.90	170.17	177.79	277.23	430.18	568.73	636.01	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	719.89	693.92	621.89	505.67	383.60	253.90	170.17	177.79	277.23	430.67	584.42	710.96	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	46.42	13.29	2.95	0.24	0.01	0.00	0.00	0.00	0.00	0.36	11.30	55.76	

∑(98)1...5, 10...12 = 130.33 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 1.79 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		1.00 (303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	130.33		(98)
Space heat from boilers		(98) x (304a) x (305) x (306) = 136.85	(307a)

Water heating

Annual water heating requirement	1783.55		(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) = 1872.73	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] = 20.10	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	119.67		(330a)
Total electricity for the above, kWh/year		119.67	(331)
Electricity for lighting (Appendix L)		321.49	(332)

Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2450.74	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	136.85	x	4.24	x 0.01 =	5.80	(340a)
Water heating from boilers	1872.73	x	4.24	x 0.01 =	79.40	(342a)
Pumps and fans	119.67	x	13.19	x 0.01 =	15.79	(349)
Electricity for lighting	321.49	x	13.19	x 0.01 =	42.40	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		263.40	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.94	(357)
SAP value	86.92	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2063.22	x	0.216	=	445.66	(367)
Electrical energy for community heat distribution	20.10	x	0.519	=	10.43	(372)
Total CO2 associated with community systems					456.09	(373)
Total CO2 associated with space and water heating					456.09	(376)
Pumps and fans	119.67	x	0.519	=	62.11	(378)
Electricity for lighting	321.49	x	0.519	=	166.85	(379)
Total CO_2, kg/year				(376)..(382) =	685.05	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.38	(384)
EI value					92.22	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2063.22	x	1.22	=	2517.13	(367)
Electrical energy for community heat distribution	20.10	x	3.07	=	61.69	(372)
Total primary energy associated with community systems					2578.82	(373)
Total primary energy associated with space and water heating					2578.82	(376)
Pumps and fans	119.67	x	3.07	=	367.40	(378)
Electricity for lighting	321.49	x	3.07	=	986.98	(379)
Primary energy kWh/year					3933.20	(383)
Dwelling primary energy rate kWh/m2/year					53.88	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Do 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.00	(1a) x	2.50	(2a) =	182.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.63	x	1.24	=	21.79			(27)
External wall			13.62	x	0.15	=	2.04			(29a)
Party wall			75.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			31.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.83 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.69 (36)
Total fabric heat loss	(33) + (36) =	28.52 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)

Heat transfer coefficient, W/K (37)m + (38)m

44.36	44.17	43.98	43.02	42.82	41.86	41.86	41.67	42.25	42.82	43.21	43.59	

Average = ∑(39)1...12/12 = 42.97 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.61	0.61	0.60	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.59	0.60	

Average = ∑(40)1...12/12 = 0.59 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.32 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.22 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.14	94.57	91.01	87.44	83.87	80.30	80.30	83.87	87.44	91.01	94.57	98.14	

∑(44)1...12 = 1070.66 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.54	127.29	131.36	114.52	109.88	94.82	87.87	100.83	102.03	118.91	129.80	140.95	

∑(45)1...12 = 1403.80 (45)

Distribution loss 0.15 x (45)m

21.83	19.09	19.70	17.18	16.48	14.22	13.18	15.12	15.30	17.84	19.47	21.14	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	

∑(64)1...12 = 1783.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.20	65.63	69.48	63.05	62.34	56.50	55.02	59.33	58.90	65.34	68.13	72.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.51	40.42	32.87	24.89	18.60	15.71	16.97	22.06	29.61	37.59	43.88	46.78	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.77	307.93	299.96	283.00	261.58	241.45	228.00	224.84	232.81	249.78	271.19	291.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	(71)
Water heating gains (Table 5)	99.73	97.66	93.38	87.57	83.79	78.47	73.95	79.74	81.80	87.82	94.62	97.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	547.56	543.57	523.77	493.00	461.52	433.18	416.47	424.19	441.77	472.74	507.24	533.32	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	17.63	x	36.79	x 0.9 x	0.50	x	0.90	=	202.29	(79)

Solar gains in watts ∑(74)m...(82)m

202.29	344.57	471.46	584.16	654.31	649.58	626.26	573.93	510.49	380.83	242.30	173.12	(83)

Total gains - internal and solar (73)m + (83)m

749.84	888.14	995.23	1077.16	1115.83	1082.76	1042.74	998.12	952.26	853.57	749.54	706.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.89	0.77	0.64	0.48	0.36	0.25	0.18	0.19	0.31	0.52	0.78	0.91	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.90	20.97	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.97	20.87	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.42	20.43	20.43	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.87	0.75	0.61	0.46	0.34	0.23	0.15	0.17	0.28	0.49	0.75	0.90	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.30	20.39	20.42	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.41	20.28	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.53	20.61	20.64	20.66	20.66	20.66	20.66	20.67	20.66	20.66	20.63	20.51	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.53	20.61	20.64	20.66	20.66	20.66	20.66	20.67	20.66	20.66	20.63	20.51	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.88	0.76	0.62	0.47	0.34	0.23	0.16	0.18	0.29	0.50	0.76	0.90	(94)
Useful gains, ηmGm, W (94)m x (84)m	657.50	674.15	617.92	505.34	383.58	253.90	170.17	177.79	277.23	430.18	568.73	636.01	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	719.89	693.92	621.89	505.67	383.60	253.90	170.17	177.79	277.23	430.67	584.42	710.96	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	46.42	13.29	2.95	0.24	0.01	0.00	0.00	0.00	0.00	0.36	11.30	55.76	

∑(98)1...5, 10...12 = 130.33 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 1.79 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	130.33		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	27.37	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	109.48	(307b)

Water heating

Annual water heating requirement	1783.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	374.55	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1498.18	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.10	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	119.67		(330a)
Total electricity for the above, kWh/year		119.67	(331)
Electricity for lighting (Appendix L)		321.49	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2450.74	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	27.37	x	2.97	x 0.01 =	0.81	(340a)
Space heating from boilers	109.48	x	4.24	x 0.01 =	4.64	(340b)
Water heating from CHP	374.55	x	2.97	x 0.01 =	11.12	(342a)
Water heating from boilers	1498.18	x	4.24	x 0.01 =	63.52	(342b)
Pumps and fans	119.67	x	13.19	x 0.01 =	15.79	(349)
Electricity for lighting	321.49	x	13.19	x 0.01 =	42.40	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		258.29	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.92	(357)
SAP value	87.18	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	50.6442	x	0.2160	=	10.9391	(363)
less credit emissions for electricity		-16.7915	x	0.5190	=	-8.7148	(364)
Water heated by CHP		693.0366	x	0.2160	=	149.6959	(365)
less credit emissions for electricity		-229.7825	x	0.5190	=	-119.2571	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1650.58	x	0.216	=	356.52	(368)
Electrical energy for community heat distribution		20.10	x	0.519	=	10.43	(372)
Total CO2 associated with community systems						399.62	(373)
Total CO2 associated with space and water heating						399.62	(376)
Pumps and fans		119.67	x	0.519	=	62.11	(378)
Electricity for lighting		321.49	x	0.519	=	166.85	(379)
Total CO_2, kg/year					(376)..(382) =	628.58	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	8.61	(384)
EI value						92.86	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	50.64	x	1.22	=	61.79	(363)
less credit energy for electricity		-16.79	x	3.07	=	-51.55	(364)
Water heated by CHP		693.04	x	1.22	=	845.50	(365)
less credit energy for electricity		-229.78	x	3.07	=	-705.43	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1650.58	x	1.22	=	2013.70	(368)
Electrical energy for community heat distribution		20.10	x	3.07	=	61.69	(372)
Total primary energy associated with community systems						2225.71	(373)
Total primary energy associated with space and water heating						2225.71	(376)
Pumps and fans		119.67	x	3.07	=	367.40	(378)
Electricity for lighting		321.49	x	3.07	=	986.98	(379)
Primary energy kWh/year						3580.08	(383)
Dwelling primary energy rate kWh/m2/year						49.04	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Do 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.00	(1a) x	2.50	(2a) =	182.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.63	x	1.24	=	21.79			(27)
External wall			13.62	x	0.15	=	2.04			(29a)
Party wall			75.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			31.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.83 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.69 (36)
Total fabric heat loss	(33) + (36) =	28.52 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)

Heat transfer coefficient, W/K (37)m + (38)m

44.36	44.17	43.98	43.02	42.82	41.86	41.86	41.67	42.25	42.82	43.21	43.59	

Average = ∑(39)1...12/12 = 42.97 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.61	0.61	0.60	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.59	0.60	

Average = ∑(40)1...12/12 = 0.59 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.32 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.22 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.14	94.57	91.01	87.44	83.87	80.30	80.30	83.87	87.44	91.01	94.57	98.14	

∑(44)1...12 = 1070.66 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.54	127.29	131.36	114.52	109.88	94.82	87.87	100.83	102.03	118.91	129.80	140.95	

∑(45)1...12 = 1403.80 (45)

Distribution loss 0.15 x (45)m

21.83	19.09	19.70	17.18	16.48	14.22	13.18	15.12	15.30	17.84	19.47	21.14	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	

∑(64)1...12 = 1783.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.20	65.63	69.48	63.05	62.34	56.50	55.02	59.33	58.90	65.34	68.13	72.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.51	40.42	32.87	24.89	18.60	15.71	16.97	22.06	29.61	37.59	43.88	46.78	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.77	307.93	299.96	283.00	261.58	241.45	228.00	224.84	232.81	249.78	271.19	291.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	(71)
Water heating gains (Table 5)	99.73	97.66	93.38	87.57	83.79	78.47	73.95	79.74	81.80	87.82	94.62	97.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	547.56	543.57	523.77	493.00	461.52	433.18	416.47	424.19	441.77	472.74	507.24	533.32	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	17.63	x	36.79	x 0.9 x	0.50	x	0.90	=	202.29	(79)

Solar gains in watts ∑(74)m...(82)m

202.29	344.57	471.46	584.16	654.31	649.58	626.26	573.93	510.49	380.83	242.30	173.12	(83)

Total gains - internal and solar (73)m + (83)m

749.84	888.14	995.23	1077.16	1115.83	1082.76	1042.74	998.12	952.26	853.57	749.54	706.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.89	0.77	0.64	0.48	0.36	0.25	0.18	0.19	0.31	0.52	0.78	0.91	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.90	20.97	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.97	20.87	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.42	20.43	20.43	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.44	20.43

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.87	0.75	0.61	0.46	0.34	0.23	0.15	0.17	0.28	0.49	0.75	0.90

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.30	20.39	20.42	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.41	20.28

(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.53	20.61	20.64	20.66	20.66	20.66	20.66	20.67	20.66	20.66	20.63	20.51

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.53	20.61	20.64	20.66	20.66	20.66	20.66	20.67	20.66	20.66	20.63	20.51

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.88	0.76	0.62	0.47	0.34	0.23	0.16	0.18	0.29	0.50	0.76	0.90	(94)
Useful gains, ηmGm, W (94)m x (84)m	657.50	674.15	617.92	505.34	383.58	253.90	170.17	177.79	277.23	430.18	568.73	636.01	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	719.89	693.92	621.89	505.67	383.60	253.90	170.17	177.79	277.23	430.67	584.42	710.96	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	46.42	13.29	2.95	0.24	0.01	0.00	0.00	0.00	0.00	0.36	11.30	55.76	

∑(98)1...5, 10...12 = 130.33 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 1.79 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	130.33		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	27.37	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	109.48	(307b)

Water heating

Annual water heating requirement	1783.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	374.55	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1498.18	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.10	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	119.67		(330a)
Total electricity for the above, kWh/year		119.67	(331)
Electricity for lighting (Appendix L)		321.49	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2217.57	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	27.37	x	2.97	x 0.01 =	0.81	(340a)
Space heating from boilers	109.48	x	4.24	x 0.01 =	4.64	(340b)
Water heating from CHP	374.55	x	2.97	x 0.01 =	11.12	(342a)
Water heating from boilers	1498.18	x	4.24	x 0.01 =	63.52	(342b)
Pumps and fans	119.67	x	13.19	x 0.01 =	15.79	(349)
Electricity for lighting	321.49	x	13.19	x 0.01 =	42.40	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		258.29	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.92	(357)
SAP value	87.18	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	50.6442	x	0.2160	=	10.9391	(363)
less credit emissions for electricity		-16.7915	x	0.5190	=	-8.7148	(364)
Water heated by CHP		693.0366	x	0.2160	=	149.6959	(365)
less credit emissions for electricity		-229.7825	x	0.5190	=	-119.2571	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1650.58	x	0.216	=	356.52	(368)
Electrical energy for community heat distribution		20.10	x	0.519	=	10.43	(372)
Total CO2 associated with community systems						399.62	(373)
Total CO2 associated with space and water heating						399.62	(376)
Pumps and fans		119.67	x	0.519	=	62.11	(378)
Electricity for lighting		321.49	x	0.519	=	166.85	(379)
Energy saving/generation technologies							
pv savings		-233.18	x	0.519	=	-121.02	(380)

Total CO_2, kg/year	(376)..(382) =	507.56	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	6.95	(384)
EI value		94.24	
EI rating (section 14)		94	(385)
EI band		A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	50.64	x	1.22	=	61.79	(363)
less credit energy for electricity		-16.79	x	3.07	=	-51.55	(364)
Water heated by CHP		693.04	x	1.22	=	845.50	(365)
less credit energy for electricity		-229.78	x	3.07	=	-705.43	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1650.58	x	1.22	=	2013.70	(368)
Electrical energy for community heat distribution		20.10	x	3.07	=	61.69	(372)
Total primary energy associated with community systems						2225.71	(373)
Total primary energy associated with space and water heating						2225.71	(376)
Pumps and fans		119.67	x	3.07	=	367.40	(378)
Electricity for lighting		321.49	x	3.07	=	986.98	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2864.23	(383)
Dwelling primary energy rate kWh/m2/year						39.24	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Dr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.00	(1a) x	2.50	(2a) =	182.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.63	x	1.24	=	21.79			(27)
External wall			13.62	x	0.15	=	2.04			(29a)
Party wall			75.00	x	0.00	=	0.00			(32)
Roof			73.00	x	0.12	=	8.76			(30)
Total area of external elements ∑A, m²			104.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.59 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.64 (36)
Total fabric heat loss	(33) + (36) =	48.23 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)

Heat transfer coefficient, W/K (37)m + (38)m

64.07	63.88	63.69	62.73	62.53	61.57	61.57	61.38	61.96	62.53	62.92	63.30	

Average = ∑(39)1...12/12 = 62.68 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.88	0.88	0.87	0.86	0.86	0.84	0.84	0.84	0.85	0.86	0.86	0.87	

Average = ∑(40)1...12/12 = 0.86 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N: 2.32 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 89.22 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.14	94.57	91.01	87.44	83.87	80.30	80.30	83.87	87.44	91.01	94.57	98.14	

∑(44)1...12 = 1070.66 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.54	127.29	131.36	114.52	109.88	94.82	87.87	100.83	102.03	118.91	129.80	140.95	

∑(45)1...12 = 1403.80 (45)

Distribution loss 0.15 x (45)m

21.83	19.09	19.70	17.18	16.48	14.22	13.18	15.12	15.30	17.84	19.47	21.14	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel: 1.00 (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.29 (48)

Temperature factor from Table 2b: 1.00 (49)

Energy lost from water storage (kWh/day) (48) x (49): 0.29 (50)

Enter (50) or (54) in (55): 0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	

∑(64)1...12 = 1783.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.20	65.63	69.48	63.05	62.34	56.50	55.02	59.33	58.90	65.34	68.13	72.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.51	40.42	32.87	24.89	18.60	15.71	16.97	22.06	29.61	37.59	43.88	46.78	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.77	307.93	299.96	283.00	261.58	241.45	228.00	224.84	232.81	249.78	271.19	291.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	(71)
Water heating gains (Table 5)	99.73	97.66	93.38	87.57	83.79	78.47	73.95	79.74	81.80	87.82	94.62	97.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	547.56	543.57	523.77	493.00	461.52	433.18	416.47	424.19	441.77	472.74	507.24	533.32	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	17.63	x	36.79	x 0.9 x	0.50	x	0.90	=	202.29	(79)

Solar gains in watts ∑(74)m...(82)m

202.29	344.57	471.46	584.16	654.31	649.58	626.26	573.93	510.49	380.83	242.30	173.12	(83)

Total gains - internal and solar (73)m + (83)m

749.84	888.14	995.23	1077.16	1115.83	1082.76	1042.74	998.12	952.26	853.57	749.54	706.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.83	0.68	0.52	0.36	0.26	0.28	0.45	0.73	0.92	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.53	20.71	20.87	20.96	20.99	21.00	21.00	21.00	21.00	20.96	20.75	20.49	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.19	20.19	20.19	20.20	20.20	20.22	20.22	20.22	20.21	20.20	20.20	20.20	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.90	0.80	0.64	0.47	0.32	0.21	0.23	0.40	0.68	0.90	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.59	19.84	20.04	20.17	20.20	20.22	20.22	20.22	20.21	20.16	19.91	19.54	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.95	20.17	20.36	20.48	20.51	20.52	20.52	20.52	20.51	20.47	20.23	19.91	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.95	20.17	20.36	20.48	20.51	20.52	20.52	20.52	20.51	20.47	20.23	19.91	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.81	0.66	0.49	0.34	0.23	0.25	0.42	0.70	0.90	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	715.15	799.24	802.47	705.94	547.66	364.21	241.28	252.87	396.61	593.68	676.53	680.93	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1002.95	975.72	882.66	726.08	550.71	364.42	241.29	252.90	397.43	617.25	826.20	994.32	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	214.12	118.60	59.66	14.50	2.27	0.00	0.00	0.00	0.00	17.54	107.77	233.16	

∑(98)1...5, 10...12 = 767.61 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.52 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	767.61		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	805.99	(307a)

Water heating

Annual water heating requirement	1783.55		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1872.73	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.79	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	119.67		(330a)
Total electricity for the above, kWh/year		119.67	(331)

Electricity for lighting (Appendix L)		321.49	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3119.88	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	805.99	x	4.24	x 0.01 =	34.17	(340a)
Water heating from boilers	1872.73	x	4.24	x 0.01 =	79.40	(342a)
Pumps and fans	119.67	x	13.19	x 0.01 =	15.79	(349)
Electricity for lighting	321.49	x	13.19	x 0.01 =	42.40	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		291.77	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.51	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2750.22	x	0.216	=	594.05	(367)
Electrical energy for community heat distribution		26.79	x	0.519	=	13.90	(372)
Total CO2 associated with community systems						607.95	(373)
Total CO2 associated with space and water heating						607.95	(376)
Pumps and fans		119.67	x	0.519	=	62.11	(378)
Electricity for lighting		321.49	x	0.519	=	166.85	(379)
Total CO_2, kg/year					(376)..(382) =	836.91	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.46	(384)
EI value						90.50	
EI rating (section 14)						90	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2750.22	x	1.22	=	3355.27	(367)
Electrical energy for community heat distribution		26.79	x	3.07	=	82.24	(372)
Total primary energy associated with community systems						3437.50	(373)
Total primary energy associated with space and water heating						3437.50	(376)
Pumps and fans		119.67	x	3.07	=	367.40	(378)
Electricity for lighting		321.49	x	3.07	=	986.98	(379)
Primary energy kWh/year						4791.88	(383)
Dwelling primary energy rate kWh/m2/year						65.64	(384)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Dr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.00	(1a) x	2.50	(2a) =	182.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.63	x	1.24	=	21.79			(27)
External wall			13.62	x	0.15	=	2.04			(29a)
Party wall			75.00	x	0.00	=	0.00			(32)
Roof			73.00	x	0.12	=	8.76			(30)
Total area of external elements ∑A, m²			104.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.59 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.64 (36)
Total fabric heat loss	(33) + (36) =	48.23 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)

Heat transfer coefficient, W/K (37)m + (38)m

64.07	63.88	63.69	62.73	62.53	61.57	61.57	61.38	61.96	62.53	62.92	63.30	

Average = ∑(39)1...12/12 = 62.68 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.88	0.88	0.87	0.86	0.86	0.84	0.84	0.84	0.85	0.86	0.86	0.87	

Average = ∑(40)1...12/12 = 0.86 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.32 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		89.22 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.14	94.57	91.01	87.44	83.87	80.30	80.30	83.87	87.44	91.01	94.57	98.14	

∑(44)1...12 = 1070.66 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.54	127.29	131.36	114.52	109.88	94.82	87.87	100.83	102.03	118.91	129.80	140.95	

∑(45)1...12 = 1403.80 (45)

Distribution loss 0.15 x (45)m

21.83	19.09	19.70	17.18	16.48	14.22	13.18	15.12	15.30	17.84	19.47	21.14	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	

∑(64)1...12 = 1783.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.20	65.63	69.48	63.05	62.34	56.50	55.02	59.33	58.90	65.34	68.13	72.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.51	40.42	32.87	24.89	18.60	15.71	16.97	22.06	29.61	37.59	43.88	46.78	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.77	307.93	299.96	283.00	261.58	241.45	228.00	224.84	232.81	249.78	271.19	291.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	(71)
Water heating gains (Table 5)	99.73	97.66	93.38	87.57	83.79	78.47	73.95	79.74	81.80	87.82	94.62	97.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	547.56	543.57	523.77	493.00	461.52	433.18	416.47	424.19	441.77	472.74	507.24	533.32	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	17.63	x	36.79	x 0.9 x	0.50	x	0.90	=	202.29	(79)

Solar gains in watts ∑(74)m...(82)m

202.29	344.57	471.46	584.16	654.31	649.58	626.26	573.93	510.49	380.83	242.30	173.12	(83)

Total gains - internal and solar (73)m + (83)m

749.84	888.14	995.23	1077.16	1115.83	1082.76	1042.74	998.12	952.26	853.57	749.54	706.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.83	0.68	0.52	0.36	0.26	0.28	0.45	0.73	0.92	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.53	20.71	20.87	20.96	20.99	21.00	21.00	21.00	21.00	20.96	20.75	20.49	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.19	20.19	20.19	20.20	20.20	20.22	20.22	20.22	20.21	20.20	20.20	20.20 (88)

Utilisation factor for gains for rest of dwelling n2,m

	0.96	0.90	0.80	0.64	0.47	0.32	0.21	0.23	0.40	0.68	0.90	0.97 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.59	19.84	20.04	20.17	20.20	20.22	20.22	20.22	20.21	20.16	19.91	19.54 (90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.95	20.17	20.36	20.48	20.51	20.52	20.52	20.52	20.51	20.47	20.23	19.91 (92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.95	20.17	20.36	20.48	20.51	20.52	20.52	20.52	20.51	20.47	20.23	19.91 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.81	0.66	0.49	0.34	0.23	0.25	0.42	0.70	0.90	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	715.15	799.24	802.47	705.94	547.66	364.21	241.28	252.87	396.61	593.68	676.53	680.93	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1002.95	975.72	882.66	726.08	550.71	364.42	241.29	252.90	397.43	617.25	826.20	994.32	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	214.12	118.60	59.66	14.50	2.27	0.00	0.00	0.00	0.00	17.54	107.77	233.16	

∑(98)1...5, 10...12 = 767.61 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.52 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	767.61		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	161.20	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	644.79	(307b)

Water heating

Annual water heating requirement	1783.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	374.55	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1498.18	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.79	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	119.67		(330a)
Total electricity for the above, kWh/year		119.67	(331)
Electricity for lighting (Appendix L)		321.49	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3119.88	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	161.20	x	2.97	x 0.01 =	4.79	(340a)
Space heating from boilers	644.79	x	4.24	x 0.01 =	27.34	(340b)
Water heating from CHP	374.55	x	2.97	x 0.01 =	11.12	(342a)
Water heating from boilers	1498.18	x	4.24	x 0.01 =	63.52	(342b)
Pumps and fans	119.67	x	13.19	x 0.01 =	15.79	(349)
Electricity for lighting	321.49	x	13.19	x 0.01 =	42.40	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		284.96	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.01	(357)
SAP value	85.85	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	298.2700	x	0.2160	=	64.4263	(363)
less credit emissions for electricity		-98.8941	x	0.5190	=	-51.3260	(364)
Water heated by CHP		693.0366	x	0.2160	=	149.6959	(365)
less credit emissions for electricity		-229.7825	x	0.5190	=	-119.2571	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2200.18	x	0.216	=	475.24	(368)
Electrical energy for community heat distribution		26.79	x	0.519	=	13.90	(372)
Total CO2 associated with community systems						532.68	(373)
Total CO2 associated with space and water heating						532.68	(376)
Pumps and fans		119.67	x	0.519	=	62.11	(378)
Electricity for lighting		321.49	x	0.519	=	166.85	(379)
Total CO_2, kg/year					(376)..(382) =	761.64	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.43	(384)
EI value						91.35	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	298.27	x	1.22	=	363.89	(363)
less credit energy for electricity		-98.89	x	3.07	=	-303.60	(364)
Water heated by CHP		693.04	x	1.22	=	845.50	(365)
less credit energy for electricity		-229.78	x	3.07	=	-705.43	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2200.18	x	1.22	=	2684.21	(368)
Electrical energy for community heat distribution		26.79	x	3.07	=	82.24	(372)
Total primary energy associated with community systems						2966.81	(373)
Total primary energy associated with space and water heating						2966.81	(376)
Pumps and fans		119.67	x	3.07	=	367.40	(378)
Electricity for lighting		321.49	x	3.07	=	986.98	(379)
Primary energy kWh/year						4321.19	(383)
Dwelling primary energy rate kWh/m2/year						59.19	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Dr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.00	(1a) x	2.50	(2a) =	182.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	182.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.63	x	1.24	=	21.79			(27)
External wall			13.62	x	0.15	=	2.04			(29a)
Party wall			75.00	x	0.00	=	0.00			(32)
Roof			73.00	x	0.12	=	8.76			(30)
Total area of external elements ∑A, m²			104.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.59 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.64 (36)
Total fabric heat loss	(33) + (36) =	48.23 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.84	15.65	15.46	14.50	14.31	13.35	13.35	13.16	13.73	14.31	14.69	15.08	(38)

Heat transfer coefficient, W/K (37)m + (38)m

64.07	63.88	63.69	62.73	62.53	61.57	61.57	61.38	61.96	62.53	62.92	63.30	

Average = ∑(39)1...12/12 = 62.68 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.88	0.88	0.87	0.86	0.86	0.84	0.84	0.84	0.85	0.86	0.86	0.87	

Average = ∑(40)1...12/12 = 0.86 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N: 2.32 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 89.22 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
98.14	94.57	91.01	87.44	83.87	80.30	80.30	83.87	87.44	91.01	94.57	98.14	

∑(44)1...12 = 1070.66 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.54	127.29	131.36	114.52	109.88	94.82	87.87	100.83	102.03	118.91	129.80	140.95	

∑(45)1...12 = 1403.80 (45)

Distribution loss 0.15 x (45)m

21.83	19.09	19.70	17.18	16.48	14.22	13.18	15.12	15.30	17.84	19.47	21.14	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel: 1.00 (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.29 (48)

Temperature factor from Table 2b: 1.00 (49)

Energy lost from water storage (kWh/day) (48) x (49): 0.29 (50)

Enter (50) or (54) in (55): 0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.80	156.43	163.61	145.73	142.14	126.03	120.12	133.08	133.24	151.16	161.01	173.20	

∑(64)1...12 = 1783.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.20	65.63	69.48	63.05	62.34	56.50	55.02	59.33	58.90	65.34	68.13	72.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.51	40.42	32.87	24.89	18.60	15.71	16.97	22.06	29.61	37.59	43.88	46.78	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	304.77	307.93	299.96	283.00	261.58	241.45	228.00	224.84	232.81	249.78	271.19	291.32	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	51.22	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	-92.67	(71)
Water heating gains (Table 5)	99.73	97.66	93.38	87.57	83.79	78.47	73.95	79.74	81.80	87.82	94.62	97.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	547.56	543.57	523.77	493.00	461.52	433.18	416.47	424.19	441.77	472.74	507.24	533.32	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	17.63	x	36.79	x 0.9 x	0.50	x	0.90	=	202.29	(79)

Solar gains in watts ∑(74)m...(82)m

202.29	344.57	471.46	584.16	654.31	649.58	626.26	573.93	510.49	380.83	242.30	173.12	(83)

Total gains - internal and solar (73)m + (83)m

749.84	888.14	995.23	1077.16	1115.83	1082.76	1042.74	998.12	952.26	853.57	749.54	706.44	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.83	0.68	0.52	0.36	0.26	0.28	0.45	0.73	0.92	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.53	20.71	20.87	20.96	20.99	21.00	21.00	21.00	21.00	20.96	20.75	20.49	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.19	20.19	20.19	20.20	20.20	20.22	20.22	20.22	20.21	20.20	20.20	20.20	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.96	0.90	0.80	0.64	0.47	0.32	0.21	0.23	0.40	0.68	0.90	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.59	19.84	20.04	20.17	20.20	20.22	20.22	20.22	20.21	20.16	19.91	19.54	(90)

Living area fraction — Living area ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.95	20.17	20.36	20.48	20.51	20.52	20.52	20.52	20.51	20.47	20.23	19.91	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.95	20.17	20.36	20.48	20.51	20.52	20.52	20.52	20.51	20.47	20.23	19.91	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.81	0.66	0.49	0.34	0.23	0.25	0.42	0.70	0.90	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	715.15	799.24	802.47	705.94	547.66	364.21	241.28	252.87	396.61	593.68	676.53	680.93	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1002.95	975.72	882.66	726.08	550.71	364.42	241.29	252.90	397.43	617.25	826.20	994.32	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	214.12	118.60	59.66	14.50	2.27	0.00	0.00	0.00	0.00	17.54	107.77	233.16	

∑(98)1...5, 10...12 = 767.61 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.52 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	767.61		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	161.20	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	644.79	(307b)

Water heating

Annual water heating requirement	1783.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	374.55	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1498.18	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.79	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	119.67		(330a)
Total electricity for the above, kWh/year		119.67	(331)
Electricity for lighting (Appendix L)		321.49	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2886.70	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	161.20	x	2.97	x 0.01 =	4.79	(340a)
Space heating from boilers	644.79	x	4.24	x 0.01 =	27.34	(340b)
Water heating from CHP	374.55	x	2.97	x 0.01 =	11.12	(342a)
Water heating from boilers	1498.18	x	4.24	x 0.01 =	63.52	(342b)
Pumps and fans	119.67	x	13.19	x 0.01 =	15.79	(349)
Electricity for lighting	321.49	x	13.19	x 0.01 =	42.40	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		284.96	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.01	(357)
SAP value	85.85	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	298.2700	x	0.2160	=	64.4263	(363)
less credit emissions for electricity		-98.8941	x	0.5190	=	-51.3260	(364)
Water heated by CHP		693.0366	x	0.2160	=	149.6959	(365)
less credit emissions for electricity		-229.7825	x	0.5190	=	-119.2571	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2200.18	x	0.216	=	475.24	(368)
Electrical energy for community heat distribution		26.79	x	0.519	=	13.90	(372)
Total CO2 associated with community systems						532.68	(373)
Total CO2 associated with space and water heating						532.68	(376)
Pumps and fans		119.67	x	0.519	=	62.11	(378)
Electricity for lighting		321.49	x	0.519	=	166.85	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	640.63	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	8.78	(384)
EI value					92.73	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	298.27	x	1.22	=	363.89	(363)
less credit energy for electricity		-98.89	x	3.07	=	-303.60	(364)
Water heated by CHP		693.04	x	1.22	=	845.50	(365)
less credit energy for electricity		-229.78	x	3.07	=	-705.43	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2200.18	x	1.22	=	2684.21	(368)
Electrical energy for community heat distribution		26.79	x	3.07	=	82.24	(372)
Total primary energy associated with community systems						2966.81	(373)
Total primary energy associated with space and water heating						2966.81	(376)
Pumps and fans		119.67	x	3.07	=	367.40	(378)
Electricity for lighting		321.49	x	3.07	=	986.98	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3605.33	(383)
Dwelling primary energy rate kWh/m2/year						49.39	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Ef 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
Exposed floor			65.00	x	0.20	=	13.00			(28b
External wall			16.33	x	0.15	=	2.45			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			95.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.34 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.25 (36)
Total fabric heat loss	(33) + (36) =	46.59 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.70	60.53	60.36	59.50	59.33	58.48	58.48	58.31	58.82	59.33	59.67	60.02	

Average = ∑(39)1...12/12 = 59.46 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.93	0.93	0.93	0.92	0.91	0.90	0.90	0.90	0.90	0.91	0.92	0.92	

Average = ∑(40)1...12/12 = 0.91 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.87	0.74	0.58	0.41	0.29	0.32	0.50	0.78	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.44	20.62	20.79	20.93	20.99	21.00	21.00	21.00	21.00	20.93	20.68	20.41

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.14	20.14	20.14	20.15	20.16	20.17	20.17	20.17	20.16	20.16	20.15	20.15

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.84	0.70	0.53	0.36	0.24	0.26	0.44	0.73	0.92	0.97

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.43	19.67	19.91	20.09	20.14	20.17	20.17	20.17	20.16	20.09	19.77	19.38

(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.85	20.07	20.28	20.44	20.50	20.51	20.52	20.52	20.51	20.44	20.15	19.81

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.85	20.07	20.28	20.44	20.50	20.51	20.52	20.52	20.51	20.44	20.15	19.81

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.92	0.85	0.72	0.55	0.38	0.26	0.29	0.47	0.75	0.92	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	636.97	708.48	720.29	651.04	515.08	345.26	228.90	239.93	375.03	546.46	604.63	607.87	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	944.02	918.02	831.59	686.58	521.87	345.84	228.95	240.01	376.97	583.62	778.59	936.75	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	228.44	140.82	82.81	25.59	5.05	0.00	0.00	0.00	0.00	27.65	125.25	244.68	

∑(98)1...5, 10...12 = 880.30 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.54 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	880.30		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	924.32	(307a)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1795.12	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.19	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	106.56	(330a)

Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		291.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3117.84	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	924.32	x	4.24	x 0.01 =	39.19	(340a)
Water heating from boilers	1795.12	x	4.24	x 0.01 =	76.11	(342a)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		287.85	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.67	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2792.03	x	0.216	=	603.08	(367)
Electrical energy for community heat distribution		27.19	x	0.519	=	14.11	(372)
Total CO2 associated with community systems						617.19	(373)
Total CO2 associated with space and water heating						617.19	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		291.83	x	0.519	=	151.46	(379)
Total CO_2, kg/year					(376)..(382) =	823.96	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.68	(384)
EI value						89.96	
EI rating (section 14)						90	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2792.03	x	1.22	=	3406.28	(367)
Electrical energy for community heat distribution		27.19	x	3.07	=	83.49	(372)
Total primary energy associated with community systems						3489.77	(373)
Total primary energy associated with space and water heating						3489.77	(376)
Pumps and fans		106.56	x	3.07	=	327.14	(378)
Electricity for lighting		291.83	x	3.07	=	895.93	(379)
Primary energy kWh/year						4712.84	(383)

Dwelling primary energy rate kWh/m2/year	72.51	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Ef 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
Exposed floor			65.00	x	0.20	=	13.00			(28b
External wall			16.33	x	0.15	=	2.45			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			95.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.34 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.25 (36)
Total fabric heat loss	(33) + (36) =	46.59 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.70	60.53	60.36	59.50	59.33	58.48	58.48	58.31	58.82	59.33	59.67	60.02	

Average = ∑(39)1...12/12 = 59.46 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.93	0.93	0.93	0.92	0.91	0.90	0.90	0.90	0.90	0.91	0.92	0.92	

Average = ∑(40)1...12/12 = 0.91 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.87	0.74	0.58	0.41	0.29	0.32	0.50	0.78	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.44	20.62	20.79	20.93	20.99	21.00	21.00	21.00	21.00	20.93	20.68	20.41	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.14	20.14	20.14	20.15	20.16	20.17	20.17	20.17	20.16	20.16	20.15	20.15	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.84	0.70	0.53	0.36	0.24	0.26	0.44	0.73	0.92	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.43	19.67	19.91	20.09	20.14	20.17	20.17	20.17	20.16	20.09	19.77	19.38	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.85	20.07	20.28	20.44	20.50	20.51	20.52	20.52	20.51	20.44	20.15	19.81	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.85	20.07	20.28	20.44	20.50	20.51	20.52	20.52	20.51	20.44	20.15	19.81	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.92	0.85	0.72	0.55	0.38	0.26	0.29	0.47	0.75	0.92	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	636.97	708.48	720.29	651.04	515.08	345.26	228.90	239.93	375.03	546.46	604.63	607.87	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	944.02	918.02	831.59	686.58	521.87	345.84	228.95	240.01	376.97	583.62	778.59	936.75	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	228.44	140.82	82.81	25.59	5.05	0.00	0.00	0.00	0.00	27.65	125.25	244.68	

∑(98)1...5, 10...12 = 880.30 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.54 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	880.30		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	184.86	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	739.45	(307b)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	359.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1436.10	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.19	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		291.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3117.84	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	184.86	x	2.97	x 0.01 =	5.49	(340a)
Space heating from boilers	739.45	x	4.24	x 0.01 =	31.35	(340b)
Water heating from CHP	359.02	x	2.97	x 0.01 =	10.66	(342a)
Water heating from boilers	1436.10	x	4.24	x 0.01 =	60.89	(342b)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		280.95	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.04	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	342.0606	x	0.2160	=	73.8851	(363)
less credit emissions for electricity		-113.4132	x	0.5190	=	-58.8615	(364)
Water heated by CHP		664.3181	x	0.2160	=	143.4927	(365)
less credit emissions for electricity		-220.2606	x	0.5190	=	-114.3153	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2233.63	x	0.216	=	482.46	(368)
Electrical energy for community heat distribution		27.19	x	0.519	=	14.11	(372)
Total CO2 associated with community systems						540.78	(373)
Total CO2 associated with space and water heating						540.78	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		291.83	x	0.519	=	151.46	(379)
Total CO_2, kg/year					(376)..(382) =	747.54	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.50	(384)
EI value						90.89	
EI rating (section 14)						91	(385)

EI band | B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	342.06	x	1.22	=	417.31	(363)
less credit energy for electricity		-113.41	x	3.07	=	-348.18	(364)
Water heated by CHP		664.32	x	1.22	=	810.47	(365)
less credit energy for electricity		-220.26	x	3.07	=	-676.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2233.63	x	1.22	=	2725.03	(368)
Electrical energy for community heat distribution		27.19	x	3.07	=	83.49	(372)
Total primary energy associated with community systems						3011.92	(373)
Total primary energy associated with space and water heating						3011.92	(376)
Pumps and fans		106.56	x	3.07	=	327.14	(378)
Electricity for lighting		291.83	x	3.07	=	895.93	(379)
Primary energy kWh/year						4234.98	(383)
Dwelling primary energy rate kWh/m2/year						65.15	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ef 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			10.79	x	1.24	=	13.33			(27)
Exposed floor			65.00	x	0.20	=	13.00			(28b
External wall			19.21	x	0.15	=	2.88			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			95.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.22 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.25 (36)
Total fabric heat loss	(33) + (36) =	43.47 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

57.57	57.40	57.23	56.38	56.20	55.35	55.35	55.18	55.69	56.20	56.55	56.89	

Average = ∑(39)1...12/12 = 56.33 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.89	0.88	0.88	0.87	0.86	0.85	0.85	0.85	0.86	0.86	0.87	0.88	

Average = ∑(40)1...12/12 = 0.87 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.38	36.76	29.89	22.63	16.92	14.28	15.43	20.06	26.92	34.18	39.90	42.53	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.55	502.84	484.69	456.51	427.78	401.83	386.49	393.74	409.79	438.15	469.75	493.55	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)

Solar gains in watts ∑(74)m...(82)m

123.81	210.89	288.55	357.52	400.45	397.56	383.29	351.26	312.43	233.08	148.29	105.95	(83)

Total gains - internal and solar (73)m + (83)m

630.35	713.73	773.23	814.03	828.23	799.39	769.78	745.00	722.22	671.23	618.04	599.50	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.95	0.89	0.78	0.62	0.44	0.32	0.34	0.53	0.80	0.94	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.47	20.62	20.79	20.92	20.98	21.00	21.00	21.00	21.00	20.93	20.69	20.44	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.18	20.18	20.18	20.20	20.20	20.21	20.21	20.21	20.20	20.20	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.93	0.87	0.74	0.57	0.39	0.26	0.28	0.47	0.75	0.93	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.50	19.71	19.93	20.12	20.18	20.21	20.21	20.21	20.20	20.12	19.82	19.46	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.91	20.09	20.29	20.45	20.52	20.54	20.54	20.54	20.53	20.46	20.18	19.87	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.91	20.09	20.29	20.45	20.52	20.54	20.54	20.54	20.53	20.46	20.18	19.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.93	0.87	0.75	0.59	0.41	0.28	0.31	0.49	0.77	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	607.93	665.28	673.39	612.02	487.80	328.03	217.98	228.38	356.21	516.27	573.47	582.36	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	898.55	872.07	789.19	651.38	495.60	328.67	218.03	228.46	358.25	554.09	739.88	891.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	216.22	138.97	86.16	28.34	5.80	0.00	0.00	0.00	0.00	28.13	119.81	229.99	

∑(98)1...5, 10...12 = 853.41 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.13 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	853.41		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	179.22	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	716.86	(307b)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	359.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1436.10	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.91	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		292.33	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2856.92	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	179.22	x	2.97	x 0.01 =	5.32	(340a)
Space heating from boilers	716.86	x	4.24	x 0.01 =	30.40	(340b)
Water heating from CHP	359.02	x	2.97	x 0.01 =	10.66	(342a)
Water heating from boilers	1436.10	x	4.24	x 0.01 =	60.89	(342b)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	292.33	x	13.19	x 0.01 =	38.56	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		279.89	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.09	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	331.6109	x	0.2160	=	71.6280	(363)
less credit emissions for electricity		-109.9486	x	0.5190	=	-57.0633	(364)
Water heated by CHP		664.3181	x	0.2160	=	143.4927	(365)
less credit emissions for electricity		-220.2606	x	0.5190	=	-114.3153	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2210.44	x	0.216	=	477.45	(368)
Electrical energy for community heat distribution		26.91	x	0.519	=	13.97	(372)
Total CO2 associated with community systems						535.16	(373)
Total CO2 associated with space and water heating						535.16	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		292.33	x	0.519	=	151.72	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	621.17	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.56	(384)
EI value					92.43	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	331.61	x	1.22	=	404.57	(363)
less credit energy for electricity		-109.95	x	3.07	=	-337.54	(364)
Water heated by CHP		664.32	x	1.22	=	810.47	(365)
less credit energy for electricity		-220.26	x	3.07	=	-676.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2210.44	x	1.22	=	2696.73	(368)
Electrical energy for community heat distribution		26.91	x	3.07	=	82.62	(372)
Total primary energy associated with community systems						2980.64	(373)
Total primary energy associated with space and water heating						2980.64	(376)
Pumps and fans		106.56	x	3.07	=	327.14	(378)
Electricity for lighting		292.33	x	3.07	=	897.46	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3489.38	(383)
Dwelling primary energy rate kWh/m2/year						53.68	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Eo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
External wall			16.33	x	0.15	=	2.45			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			30.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	19.34 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.50 (36)
Total fabric heat loss	(33) + (36) =	23.84 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

37.95	37.78	37.61	36.75	36.58	35.73	35.73	35.56	36.07	36.58	36.92	37.27	

Average = ∑(39)1...12/12 = 36.71 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.58	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	

Average = ∑(40)1...12/12 = 0.56 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.88	0.77	0.64	0.49	0.36	0.25	0.18	0.20	0.31	0.52	0.76	0.90	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.92	20.97	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.98	20.90	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.44	20.45	20.45	20.46	20.46	20.48	20.48	20.48	20.47	20.46	20.46	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.86	0.75	0.61	0.47	0.34	0.23	0.16	0.17	0.29	0.49	0.74	0.88	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.35	20.42	20.44	20.46	20.46	20.48	20.48	20.48	20.47	20.46	20.44	20.33	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.58	20.65	20.67	20.69	20.69	20.69	20.69	20.70	20.69	20.69	20.66	20.57	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.58	20.65	20.67	20.69	20.69	20.69	20.69	20.70	20.69	20.69	20.66	20.57	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.86	0.75	0.62	0.48	0.35	0.24	0.17	0.18	0.30	0.50	0.75	0.89	(94)
Useful gains, ηmGm, W (94)m x (84)m	573.51	580.43	530.01	432.90	328.76	217.74	146.28	152.74	237.75	368.67	490.25	557.04	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	617.95	594.94	533.01	433.15	328.78	217.74	146.28	152.74	237.75	368.99	500.80	610.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	33.06	9.75	2.23	0.18	0.01	0.00	0.00	0.00	0.00	0.24	7.59	39.44	

∑(98)1...5, 10...12 = 92.51 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 1.42 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	92.51		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	97.14	(307a)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1795.12	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	18.92	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)

Electricity for lighting (Appendix L)		291.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2290.65	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	97.14	x	4.24	x 0.01 =	4.12	(340a)
Water heating from boilers	1795.12	x	4.24	x 0.01 =	76.11	(342a)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		252.78	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.97	(357)
SAP value	86.54	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1942.77	x	0.216	=	419.64	(367)
Electrical energy for community heat distribution	18.92	x	0.519	=	9.82	(372)
Total CO2 associated with community systems					429.46	(373)
Total CO2 associated with space and water heating					429.46	(376)
Pumps and fans	106.56	x	0.519	=	55.30	(378)
Electricity for lighting	291.83	x	0.519	=	151.46	(379)
Total CO_2, kg/year				(376)..(382) =	636.23	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.79	(384)
EI value					92.25	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1942.77	x	1.22	=	2370.18	(367)
Electrical energy for community heat distribution	18.92	x	3.07	=	58.09	(372)
Total primary energy associated with community systems					2428.28	(373)
Total primary energy associated with space and water heating					2428.28	(376)
Pumps and fans	106.56	x	3.07	=	327.14	(378)
Electricity for lighting	291.83	x	3.07	=	895.93	(379)
Primary energy kWh/year					3651.34	(383)
Dwelling primary energy rate kWh/m2/year					56.17	(384)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Eo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
External wall			16.33	x	0.15	=	2.45			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			30.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	19.34 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.50 (36)
Total fabric heat loss	(33) + (36) =	23.84 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

37.95	37.78	37.61	36.75	36.58	35.73	35.73	35.56	36.07	36.58	36.92	37.27	

Average = ∑(39)1...12/12 = 36.71 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.58	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	

Average = ∑(40)1...12/12 = 0.56 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.88	0.77	0.64	0.49	0.36	0.25	0.18	0.20	0.31	0.52	0.76	0.90	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.92	20.97	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.98	20.90	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.44	20.45	20.45	20.46	20.46	20.48	20.48	20.48	20.47	20.46	20.46	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.86	0.75	0.61	0.47	0.34	0.23	0.16	0.17	0.29	0.49	0.74	0.88	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.35	20.42	20.44	20.46	20.46	20.48	20.48	20.48	20.47	20.46	20.44	20.33	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.58	20.65	20.67	20.69	20.69	20.69	20.69	20.70	20.69	20.69	20.66	20.57	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.58	20.65	20.67	20.69	20.69	20.69	20.69	20.70	20.69	20.69	20.66	20.57	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.86	0.75	0.62	0.48	0.35	0.24	0.17	0.18	0.30	0.50	0.75	0.89	(94)
Useful gains, ηmGm, W (94)m x (84)m	573.51	580.43	530.01	432.90	328.76	217.74	146.28	152.74	237.75	368.67	490.25	557.04	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	617.95	594.94	533.01	433.15	328.78	217.74	146.28	152.74	237.75	368.99	500.80	610.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	33.06	9.75	2.23	0.18	0.01	0.00	0.00	0.00	0.00	0.24	7.59	39.44	

∑(98)1...5, 10...12 = 92.51 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 1.42 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	92.51		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	19.43	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	77.71	(307b)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	359.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1436.10	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	18.92	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		291.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2290.65	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	19.43	x	2.97	x 0.01 =	0.58	(340a)
Space heating from boilers	77.71	x	4.24	x 0.01 =	3.29	(340b)
Water heating from CHP	359.02	x	2.97	x 0.01 =	10.66	(342a)
Water heating from boilers	1436.10	x	4.24	x 0.01 =	60.89	(342b)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		247.97	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.95	(357)
SAP value	86.79	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	35.9474	x	0.2160	=	7.7646	(363)
less credit emissions for electricity		-11.9187	x	0.5190	=	-6.1858	(364)
Water heated by CHP		664.3181	x	0.2160	=	143.4927	(365)
less credit emissions for electricity		-220.2606	x	0.5190	=	-114.3153	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1554.22	x	0.216	=	335.71	(368)
Electrical energy for community heat distribution		18.92	x	0.519	=	9.82	(372)
Total CO2 associated with community systems						376.29	(373)
Total CO2 associated with space and water heating						376.29	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		291.83	x	0.519	=	151.46	(379)
Total CO_2, kg/year					(376)..(382) =	583.05	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	8.97	(384)
EI value						92.90	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	35.95	x	1.22	=	43.86	(363)
less credit energy for electricity		-11.92	x	3.07	=	-36.59	(364)
Water heated by CHP		664.32	x	1.22	=	810.47	(365)
less credit energy for electricity		-220.26	x	3.07	=	-676.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1554.22	x	1.22	=	1896.15	(368)
Electrical energy for community heat distribution		18.92	x	3.07	=	58.09	(372)
Total primary energy associated with community systems						2095.77	(373)
Total primary energy associated with space and water heating						2095.77	(376)
Pumps and fans		106.56	x	3.07	=	327.14	(378)
Electricity for lighting		291.83	x	3.07	=	895.93	(379)
Primary energy kWh/year						3318.84	(383)
Dwelling primary energy rate kWh/m2/year						51.06	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Eo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
External wall			16.33	x	0.15	=	2.45			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			30.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	19.34 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.50 (36)
Total fabric heat loss	(33) + (36) =	23.84 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

37.95	37.78	37.61	36.75	36.58	35.73	35.73	35.56	36.07	36.58	36.92	37.27	

Average = ∑(39)1...12/12 = 36.71 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.58	0.58	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	

Average = ∑(40)1...12/12 = 0.56 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.88	0.77	0.64	0.49	0.36	0.25	0.18	0.20	0.31	0.52	0.76	0.90	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.92	20.97	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.98	20.90	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.44	20.45	20.45	20.46	20.46	20.48	20.48	20.48	20.47	20.46	20.46	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.86	0.75	0.61	0.47	0.34	0.23	0.16	0.17	0.29	0.49	0.74	0.88	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.35	20.42	20.44	20.46	20.46	20.48	20.48	20.48	20.47	20.46	20.44	20.33	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.58	20.65	20.67	20.69	20.69	20.69	20.69	20.70	20.69	20.69	20.66	20.57	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.58	20.65	20.67	20.69	20.69	20.69	20.69	20.70	20.69	20.69	20.66	20.57	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.86	0.75	0.62	0.48	0.35	0.24	0.17	0.18	0.30	0.50	0.75	0.89	(94)
Useful gains, ηmGm, W (94)m x (84)m	573.51	580.43	530.01	432.90	328.76	217.74	146.28	152.74	237.75	368.67	490.25	557.04	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	617.95	594.94	533.01	433.15	328.78	217.74	146.28	152.74	237.75	368.99	500.80	610.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	33.06	9.75	2.23	0.18	0.01	0.00	0.00	0.00	0.00	0.24	7.59	39.44	

∑(98)1...5, 10...12 = 92.51 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 1.42 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	92.51		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	19.43	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	77.71	(307b)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	359.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1436.10	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	18.92	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		291.83	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2057.48	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	19.43	x	2.97	x 0.01 =	0.58	(340a)
Space heating from boilers	77.71	x	4.24	x 0.01 =	3.29	(340b)
Water heating from CHP	359.02	x	2.97	x 0.01 =	10.66	(342a)
Water heating from boilers	1436.10	x	4.24	x 0.01 =	60.89	(342b)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		247.97	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.95	(357)
SAP value	86.79	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	35.9474	x	0.2160	=	7.7646	(363)
less credit emissions for electricity		-11.9187	x	0.5190	=	-6.1858	(364)
Water heated by CHP		664.3181	x	0.2160	=	143.4927	(365)
less credit emissions for electricity		-220.2606	x	0.5190	=	-114.3153	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1554.22	x	0.216	=	335.71	(368)
Electrical energy for community heat distribution		18.92	x	0.519	=	9.82	(372)
Total CO2 associated with community systems						376.29	(373)
Total CO2 associated with space and water heating						376.29	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		291.83	x	0.519	=	151.46	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	462.04	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.11	(384)
EI value					94.37	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	33.16					(361)
Heat efficiency of CHP unit	54.04					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	35.95	x	1.22	=	43.86	(363)
less credit energy for electricity	-11.92	x	3.07	=	-36.59	(364)
Water heated by CHP	664.32	x	1.22	=	810.47	(365)
less credit energy for electricity	-220.26	x	3.07	=	-676.20	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	1554.22	x	1.22	=	1896.15	(368)
Electrical energy for community heat distribution	18.92	x	3.07	=	58.09	(372)
Total primary energy associated with community systems					2095.77	(373)
Total primary energy associated with space and water heating					2095.77	(376)
Pumps and fans	106.56	x	3.07	=	327.14	(378)
Electricity for lighting	291.83	x	3.07	=	895.93	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year					2602.99	(383)
Dwelling primary energy rate kWh/m2/year					40.05	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Eo2 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
External wall			35.58	x	0.15	=	5.34			(29a)
Party wall			40.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			49.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.23 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.39 (36)
Total fabric heat loss	(33) + (36) =	29.62 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

43.72	43.55	43.38	42.53	42.36	41.50	41.50	41.33	41.84	42.36	42.70	43.04	

Average = ∑(39)1...12/12 = 42.48 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.67	0.67	0.67	0.65	0.65	0.64	0.64	0.64	0.64	0.65	0.66	0.66	

Average = ∑(40)1...12/12 = 0.65 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.84	0.72	0.56	0.42	0.29	0.21	0.23	0.36	0.60	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.82	20.92	20.97	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.93	20.79	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.37	20.37	20.37	20.38	20.38	20.40	20.40	20.40	20.39	20.38	20.38	20.37	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.82	0.69	0.54	0.39	0.27	0.18	0.20	0.33	0.56	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.14	20.27	20.34	20.38	20.38	20.40	20.40	20.40	20.39	20.38	20.30	20.11	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.42	20.54	20.61	20.64	20.64	20.65	20.65	20.65	20.65	20.64	20.57	20.39	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.42	20.54	20.61	20.64	20.64	20.65	20.65	20.65	20.65	20.64	20.57	20.39	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.83	0.70	0.55	0.40	0.28	0.19	0.21	0.34	0.58	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	605.25	636.30	598.64	497.33	378.55	250.99	167.99	175.63	273.84	422.95	540.13	583.41	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	704.86	681.16	611.96	499.11	378.70	251.00	167.99	175.63	273.87	425.12	575.02	697.03	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	74.12	30.15	9.91	1.28	0.11	0.00	0.00	0.00	0.00	1.61	25.12	84.54	

∑(98)1...5, 10...12 = 226.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	226.83		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	238.17	(307a)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1795.12	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.33	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)

Electricity for lighting (Appendix L)		291.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2431.69	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	238.17	x	4.24	x 0.01 =	10.10	(340a)
Water heating from boilers	1795.12	x	4.24	x 0.01 =	76.11	(342a)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		258.76	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.99	(357)
SAP value	86.22	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2087.58	x	0.216	=	450.92	(367)
Electrical energy for community heat distribution	20.33	x	0.519	=	10.55	(372)
Total CO2 associated with community systems					461.47	(373)
Total CO2 associated with space and water heating					461.47	(376)
Pumps and fans	106.56	x	0.519	=	55.30	(378)
Electricity for lighting	291.83	x	0.519	=	151.46	(379)
Total CO_2, kg/year				(376)..(382) =	668.24	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.28	(384)
EI value					91.86	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2087.58	x	1.22	=	2546.84	(367)
Electrical energy for community heat distribution	20.33	x	3.07	=	62.42	(372)
Total primary energy associated with community systems					2609.26	(373)
Total primary energy associated with space and water heating					2609.26	(376)
Pumps and fans	106.56	x	3.07	=	327.14	(378)
Electricity for lighting	291.83	x	3.07	=	895.93	(379)
Primary energy kWh/year					3832.33	(383)
Dwelling primary energy rate kWh/m2/year					58.96	(384)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Eo2 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
External wall			35.58	x	0.15	=	5.34			(29a)
Party wall			40.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			49.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.23 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.39 (36)
Total fabric heat loss	(33) + (36) =	29.62 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

43.72	43.55	43.38	42.53	42.36	41.50	41.50	41.33	41.84	42.36	42.70	43.04	

Average = ∑(39)1...12/12 = 42.48 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.67	0.67	0.67	0.65	0.65	0.64	0.64	0.64	0.64	0.65	0.66	0.66	

Average = ∑(40)1...12/12 = 0.65 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.84	0.72	0.56	0.42	0.29	0.21	0.23	0.36	0.60	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.82	20.92	20.97	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.93	20.79	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.37	20.37	20.37	20.38	20.38	20.40	20.40	20.40	20.39	20.38	20.38	20.37	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.82	0.69	0.54	0.39	0.27	0.18	0.20	0.33	0.56	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.14	20.27	20.34	20.38	20.38	20.40	20.40	20.40	20.39	20.38	20.30	20.11	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.42	20.54	20.61	20.64	20.64	20.65	20.65	20.65	20.65	20.64	20.57	20.39	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.42	20.54	20.61	20.64	20.64	20.65	20.65	20.65	20.65	20.64	20.57	20.39	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.83	0.70	0.55	0.40	0.28	0.19	0.21	0.34	0.58	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	605.25	636.30	598.64	497.33	378.55	250.99	167.99	175.63	273.84	422.95	540.13	583.41	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	704.86	681.16	611.96	499.11	378.70	251.00	167.99	175.63	273.87	425.12	575.02	697.03	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	74.12	30.15	9.91	1.28	0.11	0.00	0.00	0.00	0.00	1.61	25.12	84.54	

∑(98)1...5, 10...12 = 226.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	226.83		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	47.63	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	190.54	(307b)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	359.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1436.10	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.33	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		291.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2431.69	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	47.63	x	2.97	x 0.01 =	1.41	(340a)
Space heating from boilers	190.54	x	4.24	x 0.01 =	8.08	(340b)
Water heating from CHP	359.02	x	2.97	x 0.01 =	10.66	(342a)
Water heating from boilers	1436.10	x	4.24	x 0.01 =	60.89	(342b)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		253.60	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.97	(357)
SAP value	86.49	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	88.1408	x	0.2160	=	19.0384	(363)
less credit emissions for electricity		-29.2239	x	0.5190	=	-15.1672	(364)
Water heated by CHP		664.3181	x	0.2160	=	143.4927	(365)
less credit emissions for electricity		-220.2606	x	0.5190	=	-114.3153	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1670.06	x	0.216	=	360.73	(368)
Electrical energy for community heat distribution		20.33	x	0.519	=	10.55	(372)
Total CO2 associated with community systems						404.33	(373)
Total CO2 associated with space and water heating						404.33	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		291.83	x	0.519	=	151.46	(379)
Total CO_2, kg/year					(376)..(382) =	611.10	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.40	(384)
EI value						92.56	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	88.14	x	1.22	=	107.53	(363)
less credit energy for electricity		-29.22	x	3.07	=	-89.72	(364)
Water heated by CHP		664.32	x	1.22	=	810.47	(365)
less credit energy for electricity		-220.26	x	3.07	=	-676.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1670.06	x	1.22	=	2037.47	(368)
Electrical energy for community heat distribution		20.33	x	3.07	=	62.42	(372)
Total primary energy associated with community systems						2251.98	(373)
Total primary energy associated with space and water heating						2251.98	(376)
Pumps and fans		106.56	x	3.07	=	327.14	(378)
Electricity for lighting		291.83	x	3.07	=	895.93	(379)
Primary energy kWh/year						3475.05	(383)
Dwelling primary energy rate kWh/m2/year						53.46	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Eo2 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
External wall			35.58	x	0.15	=	5.34			(29a)
Party wall			40.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			49.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.23 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.39 (36)
Total fabric heat loss	(33) + (36) =	29.62 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

43.72	43.55	43.38	42.53	42.36	41.50	41.50	41.33	41.84	42.36	42.70	43.04	

Average = ∑(39)1...12/12 = 42.48 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.67	0.67	0.67	0.65	0.65	0.64	0.64	0.64	0.64	0.65	0.66	0.66	

Average = ∑(40)1...12/12 = 0.65 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.84	0.72	0.56	0.42	0.29	0.21	0.23	0.36	0.60	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.82	20.92	20.97	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.93	20.79	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.37	20.37	20.37	20.38	20.38	20.40	20.40	20.40	20.39	20.38	20.38	20.37	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.82	0.69	0.54	0.39	0.27	0.18	0.20	0.33	0.56	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.14	20.27	20.34	20.38	20.38	20.40	20.40	20.40	20.39	20.38	20.30	20.11	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.42	20.54	20.61	20.64	20.64	20.65	20.65	20.65	20.65	20.64	20.57	20.39	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.42	20.54	20.61	20.64	20.64	20.65	20.65	20.65	20.65	20.64	20.57	20.39	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.83	0.70	0.55	0.40	0.28	0.19	0.21	0.34	0.58	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	605.25	636.30	598.64	497.33	378.55	250.99	167.99	175.63	273.84	422.95	540.13	583.41	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	704.86	681.16	611.96	499.11	378.70	251.00	167.99	175.63	273.87	425.12	575.02	697.03	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	74.12	30.15	9.91	1.28	0.11	0.00	0.00	0.00	0.00	1.61	25.12	84.54	

∑(98)1...5, 10...12 = 226.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	226.83		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	47.63	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	190.54	(307b)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	359.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1436.10	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.33	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		291.83	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2198.51	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	47.63	x	2.97	x 0.01 =	1.41	(340a)
Space heating from boilers	190.54	x	4.24	x 0.01 =	8.08	(340b)
Water heating from CHP	359.02	x	2.97	x 0.01 =	10.66	(342a)
Water heating from boilers	1436.10	x	4.24	x 0.01 =	60.89	(342b)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		253.60	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.97	(357)
SAP value	86.49	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	88.1408	x	0.2160	=	19.0384	(363)
less credit emissions for electricity		-29.2239	x	0.5190	=	-15.1672	(364)
Water heated by CHP		664.3181	x	0.2160	=	143.4927	(365)
less credit emissions for electricity		-220.2606	x	0.5190	=	-114.3153	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1670.06	x	0.216	=	360.73	(368)
Electrical energy for community heat distribution		20.33	x	0.519	=	10.55	(372)
Total CO2 associated with community systems						404.33	(373)
Total CO2 associated with space and water heating						404.33	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		291.83	x	0.519	=	151.46	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	490.08	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.54	(384)
EI value					94.03	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)						
Power efficiency of CHP unit	33.16					(361)
Heat efficiency of CHP unit	54.04					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	88.14	x	1.22	=	107.53	(363)
less credit energy for electricity	-29.22	x	3.07	=	-89.72	(364)
Water heated by CHP	664.32	x	1.22	=	810.47	(365)
less credit energy for electricity	-220.26	x	3.07	=	-676.20	(366)
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367b)
Primary energy from boilers [(307b)+(310b)] x 100 ÷ (367b) =	1670.06	x	1.22	=	2037.47	(368)
Electrical energy for community heat distribution	20.33	x	3.07	=	62.42	(372)
Total primary energy associated with community systems					2251.98	(373)
Total primary energy associated with space and water heating					2251.98	(376)
Pumps and fans	106.56	x	3.07	=	327.14	(378)
Electricity for lighting	291.83	x	3.07	=	895.93	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year					2759.19	(383)
Dwelling primary energy rate kWh/m2/year					42.45	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	04/07/2018
Address	Er2 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
External wall			35.58	x	0.15	=	5.34			(29a)
Party wall			40.75	x	0.00	=	0.00			(32)
Roof			65.00	x	0.12	=	7.80			(30)
Total area of external elements ∑A, m²			114.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.03 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.14 (36)
Total fabric heat loss	(33) + (36) =	47.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

61.27	61.10	60.93	60.08	59.91	59.05	59.05	58.88	59.39	59.91	60.25	60.59	

Average = ∑(39)1...12/12 = 60.03 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.94	0.94	0.94	0.92	0.92	0.91	0.91	0.91	0.91	0.92	0.93	0.93	

Average = ∑(40)1...12/12 = 0.92 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.87	0.75	0.58	0.42	0.30	0.32	0.50	0.78	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.43	20.61	20.79	20.93	20.98	21.00	21.00	21.00	20.99	20.92	20.67	20.39	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.13	20.13	20.14	20.15	20.15	20.16	20.16	20.16	20.16	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.85	0.71	0.54	0.36	0.24	0.26	0.44	0.73	0.92	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.40	19.65	19.89	20.07	20.14	20.16	20.16	20.16	20.15	20.07	19.75	19.36	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.83	20.05	20.26	20.43	20.49	20.51	20.51	20.51	20.50	20.43	20.13	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.83	20.05	20.26	20.43	20.49	20.51	20.51	20.51	20.50	20.43	20.13	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.92	0.85	0.72	0.56	0.38	0.26	0.29	0.47	0.75	0.92	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	637.40	709.61	722.65	654.94	519.23	348.33	230.89	242.03	378.24	549.43	605.63	608.19	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	951.77	925.66	838.67	692.70	526.61	348.98	230.94	242.12	380.37	588.77	785.14	944.52	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	233.89	145.19	86.32	27.19	5.48	0.00	0.00	0.00	0.00	29.26	129.25	250.23	

∑(98)1...5, 10...12 = 906.81 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.95 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	906.81		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	952.16	(307a)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1795.12	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.47	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	106.56	(330a)

Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		291.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3145.67	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	952.16	x	4.24	x 0.01 =	40.37	(340a)
Water heating from boilers	1795.12	x	4.24	x 0.01 =	76.11	(342a)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	289.03	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.61	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2820.62	x	0.216	=	609.25	(367)
Electrical energy for community heat distribution		27.47	x	0.519	=	14.26	(372)
Total CO2 associated with community systems						623.51	(373)
Total CO2 associated with space and water heating						623.51	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		291.83	x	0.519	=	151.46	(379)
Total CO_2, kg/year					(376)..(382) =	830.28	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.77	(384)
EI value						89.89	
EI rating (section 14)						90	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2820.62	x	1.22	=	3441.15	(367)
Electrical energy for community heat distribution		27.47	x	3.07	=	84.34	(372)
Total primary energy associated with community systems						3525.49	(373)
Total primary energy associated with space and water heating						3525.49	(376)
Pumps and fans		106.56	x	3.07	=	327.14	(378)
Electricity for lighting		291.83	x	3.07	=	895.93	(379)
Primary energy kWh/year						4748.56	(383)

Dwelling primary energy rate kWh/m2/year	73.05	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Er2 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		65.00	(1a) x	2.50	(2a) =	162.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	65.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	162.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.67	x	1.24	=	16.89			(27)
External wall			35.58	x	0.15	=	5.34			(29a)
Party wall			40.75	x	0.00	=	0.00			(32)
Roof			65.00	x	0.12	=	7.80			(30)
Total area of external elements ∑A, m²			114.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.03 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.14 (36)
Total fabric heat loss	(33) + (36) =	47.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
14.11	13.94	13.76	12.91	12.74	11.88	11.88	11.71	12.23	12.74	13.08	13.42	(38)

Heat transfer coefficient, W/K (37)m + (38)m

61.27	61.10	60.93	60.08	59.91	59.05	59.05	58.88	59.39	59.91	60.25	60.59	

Average = ∑(39)1...12/12 = 60.03 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.94	0.94	0.94	0.92	0.92	0.91	0.91	0.91	0.91	0.92	0.93	0.93	

Average = ∑(40)1...12/12 = 0.92 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.12 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.52 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
92.98	89.60	86.21	82.83	79.45	76.07	76.07	79.45	82.83	86.21	89.60	92.98	

∑(44)1...12 = 1014.29 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

137.88	120.59	124.44	108.49	104.10	89.83	83.24	95.52	96.66	112.65	122.96	133.53	

∑(45)1...12 = 1329.90 (45)

Distribution loss 0.15 x (45)m

20.68	18.09	18.67	16.27	15.61	13.47	12.49	14.33	14.50	16.90	18.44	20.03	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

170.13	149.72	156.69	139.70	136.35	121.04	115.49	127.77	127.87	144.90	154.18	165.78	

∑(64)1...12 = 1709.64 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

71.65	63.40	67.18	61.04	60.41	54.84	53.48	57.56	57.11	63.26	65.86	70.20	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	127.13	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.31	36.69	29.84	22.59	16.89	14.26	15.41	20.02	26.88	34.13	39.83	42.46	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	276.65	279.53	272.29	256.89	237.45	219.18	206.97	204.10	211.33	226.74	246.18	264.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	49.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	-84.76	(71)
Water heating gains (Table 5)	96.30	94.35	90.29	84.78	81.20	76.16	71.88	77.37	79.32	85.02	91.47	94.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	506.48	502.78	484.64	456.47	427.75	401.81	386.47	393.70	409.74	438.10	469.68	493.48	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthEast	0.77	x	10.79	x	36.79	x 0.9 x	0.50	x	0.90	=	123.81	(77)
SouthWest	0.77	x	2.88	x	36.79	x 0.9 x	0.50	x	0.90	=	33.05	(79)

Solar gains in watts ∑(74)m...(82)m

156.85	267.18	365.56	452.95	507.34	503.67	485.59	445.02	395.83	295.29	187.87	134.23	(83)

Total gains - internal and solar (73)m + (83)m

663.33	769.95	850.20	909.42	935.09	905.48	872.06	838.72	805.57	733.38	657.55	627.71	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.87	0.75	0.58	0.42	0.30	0.32	0.50	0.78	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.43	20.61	20.79	20.93	20.98	21.00	21.00	21.00	20.99	20.92	20.67	20.39	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.13	20.13	20.14	20.15	20.15	20.16	20.16	20.16	20.16	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.85	0.71	0.54	0.36	0.24	0.26	0.44	0.73	0.92	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.40	19.65	19.89	20.07	20.14	20.16	20.16	20.16	20.15	20.07	19.75	19.36	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.83	20.05	20.26	20.43	20.49	20.51	20.51	20.51	20.50	20.43	20.13	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.83	20.05	20.26	20.43	20.49	20.51	20.51	20.51	20.50	20.43	20.13	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.92	0.85	0.72	0.56	0.38	0.26	0.29	0.47	0.75	0.92	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	637.40	709.61	722.65	654.94	519.23	348.33	230.89	242.03	378.24	549.43	605.63	608.19	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	951.77	925.66	838.67	692.70	526.61	348.98	230.94	242.12	380.37	588.77	785.14	944.52	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	233.89	145.19	86.32	27.19	5.48	0.00	0.00	0.00	0.00	29.26	129.25	250.23	

∑(98)1...5, 10...12 = 906.81 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.95 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	906.81		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	190.43	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	761.72	(307b)

Water heating

Annual water heating requirement	1709.64		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	359.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1436.10	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.47	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	106.56		(330a)
Total electricity for the above, kWh/year		106.56	(331)
Electricity for lighting (Appendix L)		291.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3145.67	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	190.43	x	2.97	x 0.01 =	5.66	(340a)
Space heating from boilers	761.72	x	4.24	x 0.01 =	32.30	(340b)
Water heating from CHP	359.02	x	2.97	x 0.01 =	10.66	(342a)
Water heating from boilers	1436.10	x	4.24	x 0.01 =	60.89	(342b)
Pumps and fans	106.56	x	13.19	x 0.01 =	14.06	(349)
Electricity for lighting	291.83	x	13.19	x 0.01 =	38.49	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		282.05	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.98	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	352.3625	x	0.2160	=	76.1103	(363)
less credit emissions for electricity		-116.8289	x	0.5190	=	-60.6342	(364)
Water heated by CHP		664.3181	x	0.2160	=	143.4927	(365)
less credit emissions for electricity		-220.2606	x	0.5190	=	-114.3153	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2256.49	x	0.216	=	487.40	(368)
Electrical energy for community heat distribution		27.47	x	0.519	=	14.26	(372)
Total CO2 associated with community systems						546.31	(373)
Total CO2 associated with space and water heating						546.31	(376)
Pumps and fans		106.56	x	0.519	=	55.30	(378)
Electricity for lighting		291.83	x	0.519	=	151.46	(379)
Total CO_2, kg/year					(376)..(382) =	753.08	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.59	(384)
EI value						90.83	
EI rating (section 14)						91	(385)

EI band | B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	352.36	x	1.22	=	429.88	(363)
less credit energy for electricity		-116.83	x	3.07	=	-358.66	(364)
Water heated by CHP		664.32	x	1.22	=	810.47	(365)
less credit energy for electricity		-220.26	x	3.07	=	-676.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2256.49	x	1.22	=	2752.92	(368)
Electrical energy for community heat distribution		27.47	x	3.07	=	84.34	(372)
Total primary energy associated with community systems						3042.75	(373)
Total primary energy associated with space and water heating						3042.75	(376)
Pumps and fans		106.56	x	3.07	=	327.14	(378)
Electricity for lighting		291.83	x	3.07	=	895.93	(379)
Primary energy kWh/year						4265.82	(383)
Dwelling primary energy rate kWh/m2/year						65.63	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
Exposed floor			70.80	x	0.20	=	14.16			(28b
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			124.55							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	39.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		18.68 (36)
Total fabric heat loss	(33) + (36) =	58.20 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

73.57	73.38	73.19	72.26	72.08	71.15	71.15	70.96	71.52	72.08	72.45	72.82	

Average = ∑(39)1...12/12 = 72.22 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.04	1.04	1.03	1.02	1.02	1.00	1.00	1.00	1.01	1.02	1.02	1.03	

Average = ∑(40)1...12/12 = 1.02 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.97	0.94	0.84	0.67	0.48	0.34	0.39	0.62	0.88	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.20	20.36	20.59	20.83	20.96	20.99	21.00	21.00	20.98	20.80	20.46	20.16

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.05	20.05	20.06	20.07	20.07	20.08	20.08	20.08	20.07	20.07	20.06	20.06

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.92	0.80	0.61	0.41	0.27	0.31	0.55	0.85	0.96	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.01	19.24	19.56	19.89	20.03	20.08	20.08	20.08	20.06	19.86	19.40	18.97

(90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.42	19.63	19.92	20.22	20.36	20.40	20.40	20.40	20.38	20.19	19.77	19.38

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.42	19.63	19.92	20.22	20.36	20.40	20.40	20.40	20.38	20.19	19.77	19.38

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.92	0.80	0.63	0.43	0.30	0.34	0.57	0.85	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	629.92	697.35	739.67	722.71	602.89	410.31	270.22	283.57	439.70	583.49	601.37	602.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1112.55	1080.79	982.14	817.84	623.98	412.48	270.43	283.99	449.26	691.42	917.86	1105.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	359.08	257.68	180.40	68.50	15.69	0.00	0.00	0.00	0.00	80.30	227.87	374.47	

∑(98)1...5, 10...12 = 1563.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 22.09 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1563.99		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1642.19	(307a)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1852.59	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	34.95	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	116.07	(330a)

Total electricity for the above, kWh/year		116.07	(331)
Electricity for lighting (Appendix L)		313.56	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3924.41	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1642.19	x	4.24	x 0.01 =	69.63	(340a)
Water heating from boilers	1852.59	x	4.24	x 0.01 =	78.55	(342a)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		324.85	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.18	(357)
SAP value	83.56	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3588.07	x	0.216	=	775.02	(367)
Electrical energy for community heat distribution		34.95	x	0.519	=	18.14	(372)
Total CO2 associated with community systems						793.16	(373)
Total CO2 associated with space and water heating						793.16	(376)
Pumps and fans		116.07	x	0.519	=	60.24	(378)
Electricity for lighting		313.56	x	0.519	=	162.74	(379)
Total CO_2, kg/year					(376)..(382) =	1016.14	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	14.35	(384)
EI value						88.24	
EI rating (section 14)						88	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3588.07	x	1.22	=	4377.45	(367)
Electrical energy for community heat distribution		34.95	x	3.07	=	107.29	(372)
Total primary energy associated with community systems						4484.74	(373)
Total primary energy associated with space and water heating						4484.74	(376)
Pumps and fans		116.07	x	3.07	=	356.33	(378)
Electricity for lighting		313.56	x	3.07	=	962.63	(379)
Primary energy kWh/year						5803.69	(383)

Dwelling primary energy rate kWh/m2/year	81.97	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ff 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
Exposed floor			70.80	x	0.20	=	14.16			(28b
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			124.55							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	39.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		18.68 (36)
Total fabric heat loss	(33) + (36) =	58.20 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

73.57	73.38	73.19	72.26	72.08	71.15	71.15	70.96	71.52	72.08	72.45	72.82	

Average = ∑(39)1...12/12 = 72.22 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.04	1.04	1.03	1.02	1.02	1.00	1.00	1.00	1.01	1.02	1.02	1.03	

Average = ∑(40)1...12/12 = 1.02 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.97	0.94	0.84	0.67	0.48	0.34	0.39	0.62	0.88	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.20	20.36	20.59	20.83	20.96	20.99	21.00	21.00	20.98	20.80	20.46	20.16

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.05	20.05	20.06	20.07	20.07	20.08	20.08	20.08	20.07	20.07	20.06	20.06

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.92	0.80	0.61	0.41	0.27	0.31	0.55	0.85	0.96	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.01	19.24	19.56	19.89	20.03	20.08	20.08	20.08	20.06	19.86	19.40	18.97

(90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.42	19.63	19.92	20.22	20.36	20.40	20.40	20.40	20.38	20.19	19.77	19.38

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.42	19.63	19.92	20.22	20.36	20.40	20.40	20.40	20.38	20.19	19.77	19.38

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.92	0.80	0.63	0.43	0.30	0.34	0.57	0.85	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	629.92	697.35	739.67	722.71	602.89	410.31	270.22	283.57	439.70	583.49	601.37	602.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1112.55	1080.79	982.14	817.84	623.98	412.48	270.43	283.99	449.26	691.42	917.86	1105.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	359.08	257.68	180.40	68.50	15.69	0.00	0.00	0.00	0.00	80.30	227.87	374.47	

∑(98)1...5, 10...12 = 1563.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 22.09 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1563.99		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	328.44	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1313.75	(307b)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.52	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.08	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	34.95	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	116.07	(330a)
Total electricity for the above, kWh/year	116.07	(331)
Electricity for lighting (Appendix L)	313.56	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3924.41	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	328.44	x	2.97	x 0.01 =	9.75	(340a)
Space heating from boilers	1313.75	x	4.24	x 0.01 =	55.70	(340b)
Water heating from CHP	370.52	x	2.97	x 0.01 =	11.00	(342a)
Water heating from boilers	1482.08	x	4.24	x 0.01 =	62.84	(342b)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		315.97	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.15	(357)
SAP value	84.01	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	607.7221	x	0.2160	=	131.2680	(363)
less credit emissions for electricity		-201.4957	x	0.5190	=	-104.5763	(364)
Water heated by CHP		685.5862	x	0.2160	=	148.0866	(365)
less credit emissions for electricity		-227.3122	x	0.5190	=	-117.9750	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2870.46	x	0.216	=	620.02	(368)
Electrical energy for community heat distribution		34.95	x	0.519	=	18.14	(372)
Total CO2 associated with community systems						694.96	(373)
Total CO2 associated with space and water heating						694.96	(376)
Pumps and fans		116.07	x	0.519	=	60.24	(378)
Electricity for lighting		313.56	x	0.519	=	162.74	(379)
Total CO_2, kg/year					(376)..(382) =	917.94	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.97	(384)
EI value						89.38	
EI rating (section 14)						89	(385)

EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	607.72	x	1.22	=	741.42	(363)
less credit energy for electricity		-201.50	x	3.07	=	-618.59	(364)
Water heated by CHP		685.59	x	1.22	=	836.42	(365)
less credit energy for electricity		-227.31	x	3.07	=	-697.85	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2870.46	x	1.22	=	3501.96	(368)
Electrical energy for community heat distribution		34.95	x	3.07	=	107.29	(372)
Total primary energy associated with community systems						3870.65	(373)
Total primary energy associated with space and water heating						3870.65	(376)
Pumps and fans		116.07	x	3.07	=	356.33	(378)
Electricity for lighting		313.56	x	3.07	=	962.63	(379)
Primary energy kWh/year						5189.60	(383)
Dwelling primary energy rate kWh/m2/year						73.30	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ff 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
Exposed floor			70.80	x	0.20	=	14.16			(28b
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			124.55							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	39.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		18.68 (36)
Total fabric heat loss	(33) + (36) =	58.20 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

73.57	73.38	73.19	72.26	72.08	71.15	71.15	70.96	71.52	72.08	72.45	72.82	

Average = ∑(39)1...12/12 = 72.22 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.04	1.04	1.03	1.02	1.02	1.00	1.00	1.00	1.01	1.02	1.02	1.03	

Average = ∑(40)1...12/12 = 1.02 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.97	0.94	0.84	0.67	0.48	0.34	0.39	0.62	0.88	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.20	20.36	20.59	20.83	20.96	20.99	21.00	21.00	20.98	20.80	20.46	20.16

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.05	20.05	20.06	20.07	20.07	20.08	20.08	20.08	20.07	20.07	20.06	20.06

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.92	0.80	0.61	0.41	0.27	0.31	0.55	0.85	0.96	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.01	19.24	19.56	19.89	20.03	20.08	20.08	20.08	20.06	19.86	19.40	18.97

(90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.42	19.63	19.92	20.22	20.36	20.40	20.40	20.40	20.38	20.19	19.77	19.38

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.42	19.63	19.92	20.22	20.36	20.40	20.40	20.40	20.38	20.19	19.77	19.38

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.92	0.80	0.63	0.43	0.30	0.34	0.57	0.85	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	629.92	697.35	739.67	722.71	602.89	410.31	270.22	283.57	439.70	583.49	601.37	602.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1112.55	1080.79	982.14	817.84	623.98	412.48	270.43	283.99	449.26	691.42	917.86	1105.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	359.08	257.68	180.40	68.50	15.69	0.00	0.00	0.00	0.00	80.30	227.87	374.47	

∑(98)1...5, 10...12 = 1563.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 22.09 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1563.99		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	328.44	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1313.75	(307b)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.52	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.08	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	34.95	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.07		(330a)
Total electricity for the above, kWh/year		116.07	(331)
Electricity for lighting (Appendix L)		313.56	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3691.23	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	328.44	x	2.97	x 0.01 =	9.75	(340a)
Space heating from boilers	1313.75	x	4.24	x 0.01 =	55.70	(340b)
Water heating from CHP	370.52	x	2.97	x 0.01 =	11.00	(342a)
Water heating from boilers	1482.08	x	4.24	x 0.01 =	62.84	(342b)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		315.97	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.15	(357)
SAP value	84.01	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	607.7221	x	0.2160	=	131.2680	(363)
less credit emissions for electricity		-201.4957	x	0.5190	=	-104.5763	(364)
Water heated by CHP		685.5862	x	0.2160	=	148.0866	(365)
less credit emissions for electricity		-227.3122	x	0.5190	=	-117.9750	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2870.46	x	0.216	=	620.02	(368)
Electrical energy for community heat distribution		34.95	x	0.519	=	18.14	(372)
Total CO2 associated with community systems						694.96	(373)
Total CO2 associated with space and water heating						694.96	(376)
Pumps and fans		116.07	x	0.519	=	60.24	(378)
Electricity for lighting		313.56	x	0.519	=	162.74	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	796.92	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.26	(384)
EI value					90.78	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	607.72	x	1.22	=	741.42	(363)
less credit energy for electricity		-201.50	x	3.07	=	-618.59	(364)
Water heated by CHP		685.59	x	1.22	=	836.42	(365)
less credit energy for electricity		-227.31	x	3.07	=	-697.85	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2870.46	x	1.22	=	3501.96	(368)
Electrical energy for community heat distribution		34.95	x	3.07	=	107.29	(372)
Total primary energy associated with community systems						3870.65	(373)
Total primary energy associated with space and water heating						3870.65	(376)
Pumps and fans		116.07	x	3.07	=	356.33	(378)
Electricity for lighting		313.56	x	3.07	=	962.63	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						4473.75	(383)
Dwelling primary energy rate kWh/m2/year						63.19	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Fo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			53.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	25.36 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.06 (36)
Total fabric heat loss	(33) + (36) =	33.42 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

48.79	48.60	48.41	47.48	47.30	46.37	46.37	46.18	46.74	47.30	47.67	48.04	

Average = ∑(39)1...12/12 = 47.44 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.69	0.69	0.68	0.67	0.67	0.65	0.65	0.65	0.66	0.67	0.67	0.68	

Average = ∑(40)1...12/12 = 0.67 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.92	0.81	0.63	0.46	0.31	0.22	0.25	0.42	0.70	0.91	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.72	20.83	20.94	20.99	21.00	21.00	21.00	21.00	21.00	20.98	20.87	20.69	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.35	20.35	20.36	20.37	20.37	20.38	20.38	20.38	20.38	20.37	20.36	20.36	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.95	0.90	0.79	0.60	0.43	0.28	0.19	0.22	0.38	0.66	0.89	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.99	20.15	20.28	20.36	20.37	20.38	20.38	20.38	20.38	20.35	20.21	19.96	(90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.24	20.39	20.51	20.58	20.59	20.60	20.60	20.60	20.59	20.58	20.44	20.22	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.24	20.39	20.51	20.58	20.59	20.60	20.60	20.60	20.59	20.58	20.44	20.22	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.80	0.61	0.44	0.29	0.20	0.23	0.39	0.68	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	612.10	654.48	642.81	549.81	420.10	278.07	185.35	193.91	303.43	463.95	560.66	588.97	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	777.87	752.62	678.42	554.58	420.44	278.08	185.35	193.91	303.53	471.80	635.87	769.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	123.33	65.95	26.49	3.43	0.25	0.00	0.00	0.00	0.00	5.84	54.16	134.36	

∑(98)1...5, 10...12 = 413.80 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.84 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		1.00 (303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	413.80		(98)
Space heat from boilers		(98) x (304a) x (305) x (306) = 434.49	(307a)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) = 1852.59	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] = 22.87	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	116.07		(330a)
Total electricity for the above, kWh/year		116.07	(331)

Electricity for lighting (Appendix L)		313.56	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2716.71	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	434.49	x	4.24	x 0.01 =	18.42	(340a)
Water heating from boilers	1852.59	x	4.24	x 0.01 =	78.55	(342a)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		273.64	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.99	(357)
SAP value	86.15	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2348.14	x	0.216	=	507.20	(367)
Electrical energy for community heat distribution	22.87	x	0.519	=	11.87	(372)
Total CO2 associated with community systems					519.07	(373)
Total CO2 associated with space and water heating					519.07	(376)
Pumps and fans	116.07	x	0.519	=	60.24	(378)
Electricity for lighting	313.56	x	0.519	=	162.74	(379)
Total CO_2, kg/year				(376)..(382) =	742.04	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.48	(384)
EI value					91.41	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2348.14	x	1.22	=	2864.73	(367)
Electrical energy for community heat distribution	22.87	x	3.07	=	70.21	(372)
Total primary energy associated with community systems					2934.94	(373)
Total primary energy associated with space and water heating					2934.94	(376)
Pumps and fans	116.07	x	3.07	=	356.33	(378)
Electricity for lighting	313.56	x	3.07	=	962.63	(379)
Primary energy kWh/year					4253.90	(383)
Dwelling primary energy rate kWh/m2/year					60.08	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Fo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			53.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	25.36 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.06 (36)
Total fabric heat loss	(33) + (36) =	33.42 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

48.79	48.60	48.41	47.48	47.30	46.37	46.37	46.18	46.74	47.30	47.67	48.04	

Average = ∑(39)1...12/12 = 47.44 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.69	0.69	0.68	0.67	0.67	0.65	0.65	0.65	0.66	0.67	0.67	0.68	

Average = ∑(40)1...12/12 = 0.67 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.92	0.81	0.63	0.46	0.31	0.22	0.25	0.42	0.70	0.91	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.72	20.83	20.94	20.99	21.00	21.00	21.00	21.00	21.00	20.98	20.87	20.69	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.35	20.35	20.36	20.37	20.37	20.38	20.38	20.38	20.38	20.37	20.36	20.36	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.95	0.90	0.79	0.60	0.43	0.28	0.19	0.22	0.38	0.66	0.89	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.99	20.15	20.28	20.36	20.37	20.38	20.38	20.38	20.38	20.35	20.21	19.96	(90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.24	20.39	20.51	20.58	20.59	20.60	20.60	20.60	20.59	20.58	20.44	20.22	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.24	20.39	20.51	20.58	20.59	20.60	20.60	20.60	20.59	20.58	20.44	20.22	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.80	0.61	0.44	0.29	0.20	0.23	0.39	0.68	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	612.10	654.48	642.81	549.81	420.10	278.07	185.35	193.91	303.43	463.95	560.66	588.97	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	777.87	752.62	678.42	554.58	420.44	278.08	185.35	193.91	303.53	471.80	635.87	769.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	123.33	65.95	26.49	3.43	0.25	0.00	0.00	0.00	0.00	5.84	54.16	134.36	

∑(98)1...5, 10...12 = 413.80 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.84 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	413.80		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	86.90	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	347.59	(307b)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.52	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.08	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	22.87	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.07		(330a)
Total electricity for the above, kWh/year		116.07	(331)
Electricity for lighting (Appendix L)		313.56	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2716.71	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	86.90	x	2.97	x 0.01 =	2.58	(340a)
Space heating from boilers	347.59	x	4.24	x 0.01 =	14.74	(340b)
Water heating from CHP	370.52	x	2.97	x 0.01 =	11.00	(342a)
Water heating from boilers	1482.08	x	4.24	x 0.01 =	62.84	(342b)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		267.83	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.97	(357)
SAP value	86.45	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	160.7918	x	0.2160	=	34.7310	(363)
less credit emissions for electricity		-53.3119	x	0.5190	=	-27.6689	(364)
Water heated by CHP		685.5862	x	0.2160	=	148.0866	(365)
less credit emissions for electricity		-227.3122	x	0.5190	=	-117.9750	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1878.51	x	0.216	=	405.76	(368)
Electrical energy for community heat distribution		22.87	x	0.519	=	11.87	(372)
Total CO2 associated with community systems						454.80	(373)
Total CO2 associated with space and water heating						454.80	(376)
Pumps and fans		116.07	x	0.519	=	60.24	(378)
Electricity for lighting		313.56	x	0.519	=	162.74	(379)
Total CO_2, kg/year					(376)..(382) =	677.78	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.57	(384)
EI value						92.16	
EI rating (section 14)						92	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	160.79	x	1.22	=	196.17	(363)
less credit energy for electricity		-53.31	x	3.07	=	-163.67	(364)
Water heated by CHP		685.59	x	1.22	=	836.42	(365)
less credit energy for electricity		-227.31	x	3.07	=	-697.85	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1878.51	x	1.22	=	2291.78	(368)
Electrical energy for community heat distribution		22.87	x	3.07	=	70.21	(372)
Total primary energy associated with community systems						2533.06	(373)
Total primary energy associated with space and water heating						2533.06	(376)
Pumps and fans		116.07	x	3.07	=	356.33	(378)
Electricity for lighting		313.56	x	3.07	=	962.63	(379)
Primary energy kWh/year						3852.01	(383)
Dwelling primary energy rate kWh/m2/year						54.41	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Fo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			53.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	25.36 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.06 (36)
Total fabric heat loss	(33) + (36) =	33.42 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

48.79	48.60	48.41	47.48	47.30	46.37	46.37	46.18	46.74	47.30	47.67	48.04	

Average = ∑(39)1...12/12 = 47.44 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.69	0.69	0.68	0.67	0.67	0.65	0.65	0.65	0.66	0.67	0.67	0.68	

Average = ∑(40)1...12/12 = 0.67 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.92	0.81	0.63	0.46	0.31	0.22	0.25	0.42	0.70	0.91	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.72	20.83	20.94	20.99	21.00	21.00	21.00	21.00	21.00	20.98	20.87	20.69	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.35	20.35	20.36	20.37	20.37	20.38	20.38	20.38	20.38	20.37	20.36	20.36 (88)

Utilisation factor for gains for rest of dwelling n2,m

	0.95	0.90	0.79	0.60	0.43	0.28	0.19	0.22	0.38	0.66	0.89	0.96 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.99	20.15	20.28	20.36	20.37	20.38	20.38	20.38	20.38	20.35	20.21	19.96 (90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.24	20.39	20.51	20.58	20.59	20.60	20.60	20.60	20.59	20.58	20.44	20.22 (92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.24	20.39	20.51	20.58	20.59	20.60	20.60	20.60	20.59	20.58	20.44	20.22 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.80	0.61	0.44	0.29	0.20	0.23	0.39	0.68	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	612.10	654.48	642.81	549.81	420.10	278.07	185.35	193.91	303.43	463.95	560.66	588.97	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	777.87	752.62	678.42	554.58	420.44	278.08	185.35	193.91	303.53	471.80	635.87	769.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	123.33	65.95	26.49	3.43	0.25	0.00	0.00	0.00	0.00	5.84	54.16	134.36	

∑(98)1...5, 10...12 = 413.80 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.84 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	413.80		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	86.90	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	347.59	(307b)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.52	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.08	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	22.87	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.07		(330a)
Total electricity for the above, kWh/year		116.07	(331)
Electricity for lighting (Appendix L)		313.56	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2483.54	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	86.90	x	2.97	x 0.01 =	2.58	(340a)
Space heating from boilers	347.59	x	4.24	x 0.01 =	14.74	(340b)
Water heating from CHP	370.52	x	2.97	x 0.01 =	11.00	(342a)
Water heating from boilers	1482.08	x	4.24	x 0.01 =	62.84	(342b)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		267.83	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.97	(357)
SAP value	86.45	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	160.7918	x	0.2160	=	34.7310	(363)
less credit emissions for electricity		-53.3119	x	0.5190	=	-27.6689	(364)
Water heated by CHP		685.5862	x	0.2160	=	148.0866	(365)
less credit emissions for electricity		-227.3122	x	0.5190	=	-117.9750	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1878.51	x	0.216	=	405.76	(368)
Electrical energy for community heat distribution		22.87	x	0.519	=	11.87	(372)
Total CO2 associated with community systems						454.80	(373)
Total CO2 associated with space and water heating						454.80	(376)
Pumps and fans		116.07	x	0.519	=	60.24	(378)
Electricity for lighting		313.56	x	0.519	=	162.74	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	556.76	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.86	(384)
EI value					93.56	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	160.79	x	1.22	=	196.17	(363)
less credit energy for electricity		-53.31	x	3.07	=	-163.67	(364)
Water heated by CHP		685.59	x	1.22	=	836.42	(365)
less credit energy for electricity		-227.31	x	3.07	=	-697.85	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1878.51	x	1.22	=	2291.78	(368)
Electrical energy for community heat distribution		22.87	x	3.07	=	70.21	(372)
Total primary energy associated with community systems						2533.06	(373)
Total primary energy associated with space and water heating						2533.06	(376)
Pumps and fans		116.07	x	3.07	=	356.33	(378)
Electricity for lighting		313.56	x	3.07	=	962.63	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3136.16	(383)
Dwelling primary energy rate kWh/m2/year						44.30	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Fr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Roof			70.80	x	0.12	=	8.50			(30)
Total area of external elements ∑A, m²			124.55							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	33.85 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		18.68 (36)
Total fabric heat loss	(33) + (36) =	52.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

67.90	67.72	67.53	66.60	66.41	65.48	65.48	65.30	65.85	66.41	66.79	67.16	

Average = ∑(39)1...12/12 = 66.55 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.96	0.96	0.95	0.94	0.94	0.92	0.92	0.92	0.93	0.94	0.94	0.95	

Average = ∑(40)1...12/12 = 0.94 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.97	0.92	0.81	0.62	0.44	0.32	0.36	0.58	0.86	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.31	20.47	20.68	20.89	20.98	21.00	21.00	21.00	20.99	20.86	20.56	20.28

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.12	20.12	20.12	20.13	20.14	20.15	20.15	20.15	20.14	20.14	20.13	20.13

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.90	0.77	0.57	0.38	0.26	0.29	0.51	0.82	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.22	19.45	19.74	20.01	20.12	20.14	20.15	20.15	20.13	19.99	19.58	19.19

(90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.61	19.80	20.07	20.32	20.42	20.44	20.44	20.45	20.43	20.30	19.92	19.57

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.61	19.80	20.07	20.32	20.42	20.44	20.44	20.45	20.43	20.30	19.92	19.57

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.90	0.78	0.59	0.40	0.28	0.31	0.54	0.83	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	628.41	693.37	729.01	696.83	567.28	381.67	251.70	264.03	412.09	567.56	597.63	601.38	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1039.28	1009.21	916.26	760.51	578.93	382.64	251.78	264.20	417.08	643.90	856.49	1032.13	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	305.68	212.24	139.31	45.84	8.67	0.00	0.00	0.00	0.00	56.80	186.37	320.48	

∑(98)1...5, 10...12 = 1275.41 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 18.01 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1275.41		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1339.18	(307a)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1852.59	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	31.92	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	116.07	(330a)

Total electricity for the above, kWh/year		116.07	(331)
Electricity for lighting (Appendix L)		313.56	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3621.40	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1339.18	x	4.24	x 0.01 =	56.78	(340a)
Water heating from boilers	1852.59	x	4.24	x 0.01 =	78.55	(342a)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		312.00	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.21	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3276.98	x	0.216	=	707.83	(367)
Electrical energy for community heat distribution		31.92	x	0.519	=	16.57	(372)
Total CO2 associated with community systems						724.39	(373)
Total CO2 associated with space and water heating						724.39	(376)
Pumps and fans		116.07	x	0.519	=	60.24	(378)
Electricity for lighting		313.56	x	0.519	=	162.74	(379)
Total CO_2, kg/year					(376)..(382) =	947.37	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	13.38	(384)
EI value						89.04	
EI rating (section 14)						89	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3276.98	x	1.22	=	3997.91	(367)
Electrical energy for community heat distribution		31.92	x	3.07	=	97.99	(372)
Total primary energy associated with community systems						4095.90	(373)
Total primary energy associated with space and water heating						4095.90	(376)
Pumps and fans		116.07	x	3.07	=	356.33	(378)
Electricity for lighting		313.56	x	3.07	=	962.63	(379)
Primary energy kWh/year						5414.85	(383)

Dwelling primary energy rate kWh/m2/year	76.48	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Fr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Roof			70.80	x	0.12	=	8.50			(30)
Total area of external elements ∑A, m²			124.55							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	33.85 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		18.68 (36)
Total fabric heat loss	(33) + (36) =	52.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

67.90	67.72	67.53	66.60	66.41	65.48	65.48	65.30	65.85	66.41	66.79	67.16	

Average = ∑(39)1...12/12 = 66.55 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.96	0.96	0.95	0.94	0.94	0.92	0.92	0.92	0.93	0.94	0.94	0.95	

Average = ∑(40)1...12/12 = 0.94 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.97	0.92	0.81	0.62	0.44	0.32	0.36	0.58	0.86	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.31	20.47	20.68	20.89	20.98	21.00	21.00	21.00	20.99	20.86	20.56	20.28

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.12	20.12	20.12	20.13	20.14	20.15	20.15	20.15	20.14	20.14	20.13	20.13

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.90	0.77	0.57	0.38	0.26	0.29	0.51	0.82	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.22	19.45	19.74	20.01	20.12	20.14	20.15	20.15	20.13	19.99	19.58	19.19

(90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.61	19.80	20.07	20.32	20.42	20.44	20.44	20.45	20.43	20.30	19.92	19.57

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.61	19.80	20.07	20.32	20.42	20.44	20.44	20.45	20.43	20.30	19.92	19.57

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.98	0.95	0.90	0.78	0.59	0.40	0.28	0.31	0.54	0.83	0.95	0.98
												(94)
Useful gains, ηmGm, W (94)m x (84)m	628.41	693.37	729.01	696.83	567.28	381.67	251.70	264.03	412.09	567.56	597.63	601.38
												(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
												(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1039.28	1009.21	916.26	760.51	578.93	382.64	251.78	264.20	417.08	643.90	856.49	1032.13
												(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	305.68	212.24	139.31	45.84	8.67	0.00	0.00	0.00	0.00	56.80	186.37	320.48

∑(98)1...5, 10...12 = 1275.41 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 18.01 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1275.41		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	267.84	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1071.35	(307b)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.52	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.08	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	31.92	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	116.07		(330a)
Total electricity for the above, kWh/year		116.07	(331)
Electricity for lighting (Appendix L)		313.56	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3621.40	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	267.84	x	2.97	x 0.01 =	7.95	(340a)
Space heating from boilers	1071.35	x	4.24	x 0.01 =	45.43	(340b)
Water heating from CHP	370.52	x	2.97	x 0.01 =	11.00	(342a)
Water heating from boilers	1482.08	x	4.24	x 0.01 =	62.84	(342b)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		303.89	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.62	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	495.5883	x	0.2160	=	107.0471	(363)
less credit emissions for electricity		-164.3167	x	0.5190	=	-85.2804	(364)
Water heated by CHP		685.5862	x	0.2160	=	148.0866	(365)
less credit emissions for electricity		-227.3122	x	0.5190	=	-117.9750	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2621.58	x	0.216	=	566.26	(368)
Electrical energy for community heat distribution		31.92	x	0.519	=	16.57	(372)
Total CO2 associated with community systems						634.71	(373)
Total CO2 associated with space and water heating						634.71	(376)
Pumps and fans		116.07	x	0.519	=	60.24	(378)
Electricity for lighting		313.56	x	0.519	=	162.74	(379)
Total CO_2, kg/year					(376)..(382) =	857.68	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.11	(384)
EI value						90.08	
EI rating (section 14)						90	(385)

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EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	495.59	x	1.22	=	604.62	(363)
less credit energy for electricity		-164.32	x	3.07	=	-504.45	(364)
Water heated by CHP		685.59	x	1.22	=	836.42	(365)
less credit energy for electricity		-227.31	x	3.07	=	-697.85	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2621.58	x	1.22	=	3198.33	(368)
Electrical energy for community heat distribution		31.92	x	3.07	=	97.99	(372)
Total primary energy associated with community systems						3535.05	(373)
Total primary energy associated with space and water heating						3535.05	(376)
Pumps and fans		116.07	x	3.07	=	356.33	(378)
Electricity for lighting		313.56	x	3.07	=	962.63	(379)
Primary energy kWh/year						4854.00	(383)
Dwelling primary energy rate kWh/m2/year						68.56	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Fr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.80	(1a) x	2.50	(2a) =	177.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.93	x	1.24	=	19.69			(27)
External wall			37.82	x	0.15	=	5.67			(29a)
Party wall			36.75	x	0.00	=	0.00			(32)
Roof			70.80	x	0.12	=	8.50			(30)
Total area of external elements ∑A, m²			124.55							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	33.85 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		18.68 (36)
Total fabric heat loss	(33) + (36) =	52.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.37	15.18	14.99	14.06	13.88	12.95	12.95	12.76	13.32	13.88	14.25	14.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

67.90	67.72	67.53	66.60	66.41	65.48	65.48	65.30	65.85	66.41	66.79	67.16	

Average = ∑(39)1...12/12 = 66.55 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.96	0.96	0.95	0.94	0.94	0.92	0.92	0.92	0.93	0.94	0.94	0.95	

Average = ∑(40)1...12/12 = 0.94 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.00 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.80	93.28	89.76	86.24	82.72	79.20	79.20	82.72	86.24	89.76	93.28	96.80	

∑(44)1...12 = 1056.04 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03	

∑(45)1...12 = 1384.63 (45)

Distribution loss 0.15 x (45)m

21.53	18.83	19.43	16.94	16.26	14.03	13.00	14.92	15.10	17.59	19.20	20.85	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.81	154.69	161.81	144.17	140.64	124.74	118.92	131.70	131.85	149.54	159.24	171.28	

∑(64)1...12 = 1764.38 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.53	65.05	68.88	62.53	61.84	56.07	54.62	58.87	58.43	64.80	67.54	72.03	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.39	39.42	32.06	24.27	18.14	15.32	16.55	21.51	28.88	36.67	42.79	45.62	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.50	284.13	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)
Water heating gains (Table 5)	98.84	96.80	92.58	86.84	83.12	77.87	73.41	79.13	81.16	87.10	93.80	96.81	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	536.64	532.73	513.37	483.30	452.55	424.85	408.51	416.10	433.26	463.54	497.26	522.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	9.47	x	11.28	x 0.9 x	0.50	x	0.90	=	33.32	(75)
SouthEast	0.77	x	6.46	x	36.79	x 0.9 x	0.50	x	0.90	=	74.12	(77)

Solar gains in watts ∑(74)m...(82)m

107.44	194.08	294.95	414.74	509.52	525.62	498.52	424.78	335.96	222.43	130.71	90.65	(83)

Total gains - internal and solar (73)m + (83)m

644.08	726.81	808.32	898.03	962.07	950.47	907.02	840.88	769.22	685.97	627.97	613.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.97	0.92	0.81	0.62	0.44	0.32	0.36	0.58	0.86	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.31	20.47	20.68	20.89	20.98	21.00	21.00	21.00	20.99	20.86	20.56	20.28

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.12	20.12	20.12	20.13	20.14	20.15	20.15	20.15	20.14	20.14	20.13	20.13

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.90	0.77	0.57	0.38	0.26	0.29	0.51	0.82	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.22	19.45	19.74	20.01	20.12	20.14	20.15	20.15	20.13	19.99	19.58	19.19

(90)

Living area fraction — Living area ÷ (4) = 0.35 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.61	19.80	20.07	20.32	20.42	20.44	20.44	20.45	20.43	20.30	19.92	19.57

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.61	19.80	20.07	20.32	20.42	20.44	20.44	20.45	20.43	20.30	19.92	19.57

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.98	0.95	0.90	0.78	0.59	0.40	0.28	0.31	0.54	0.83	0.95	0.98
(94)												
Useful gains, ηmGm, W (94)m x (84)m	628.41	693.37	729.01	696.83	567.28	381.67	251.70	264.03	412.09	567.56	597.63	601.38
(95)												
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
(96)												
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1039.28	1009.21	916.26	760.51	578.93	382.64	251.78	264.20	417.08	643.90	856.49	1032.13
(97)												
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	305.68	212.24	139.31	45.84	8.67	0.00	0.00	0.00	0.00	56.80	186.37	320.48

∑(98)1...5, 10...12 = 1275.41 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 18.01 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1275.41		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	267.84	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1071.35	(307b)

Water heating

Annual water heating requirement	1764.38		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.52	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.08	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	31.92	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.07		(330a)
Total electricity for the above, kWh/year		116.07	(331)
Electricity for lighting (Appendix L)		313.56	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3388.22	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	267.84	x	2.97	x 0.01 =	7.95	(340a)
Space heating from boilers	1071.35	x	4.24	x 0.01 =	45.43	(340b)
Water heating from CHP	370.52	x	2.97	x 0.01 =	11.00	(342a)
Water heating from boilers	1482.08	x	4.24	x 0.01 =	62.84	(342b)
Pumps and fans	116.07	x	13.19	x 0.01 =	15.31	(349)
Electricity for lighting	313.56	x	13.19	x 0.01 =	41.36	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		303.89	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.62	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	495.5883	x	0.2160	=	107.0471	(363)
less credit emissions for electricity		-164.3167	x	0.5190	=	-85.2804	(364)
Water heated by CHP		685.5862	x	0.2160	=	148.0866	(365)
less credit emissions for electricity		-227.3122	x	0.5190	=	-117.9750	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2621.58	x	0.216	=	566.26	(368)
Electrical energy for community heat distribution		31.92	x	0.519	=	16.57	(372)
Total CO2 associated with community systems						634.71	(373)
Total CO2 associated with space and water heating						634.71	(376)
Pumps and fans		116.07	x	0.519	=	60.24	(378)
Electricity for lighting		313.56	x	0.519	=	162.74	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	736.66	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.40	(384)
EI value					91.48	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	495.59	x	1.22	=	604.62	(363)
less credit energy for electricity		-164.32	x	3.07	=	-504.45	(364)
Water heated by CHP		685.59	x	1.22	=	836.42	(365)
less credit energy for electricity		-227.31	x	3.07	=	-697.85	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2621.58	x	1.22	=	3198.33	(368)
Electrical energy for community heat distribution		31.92	x	3.07	=	97.99	(372)
Total primary energy associated with community systems						3535.05	(373)
Total primary energy associated with space and water heating						3535.05	(376)
Pumps and fans		116.07	x	3.07	=	356.33	(378)
Electricity for lighting		313.56	x	3.07	=	962.63	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						4138.15	(383)
Dwelling primary energy rate kWh/m2/year						58.45	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Gf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
Exposed floor			40.44	x	0.19	=	7.64			(28b
External wall			14.17	x	0.15	=	2.13			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			74.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.27 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.17 (36)
Total fabric heat loss	(33) + (36) =	45.44 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

63.02	62.81	62.59	61.53	61.31	60.25	60.25	60.04	60.68	61.31	61.74	62.17	

Average = ∑(39)1...12/12 = 61.47 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.78	0.78	0.77	0.76	0.76	0.74	0.74	0.74	0.75	0.76	0.76	0.77	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.83	0.66	0.49	0.34	0.24	0.27	0.44	0.72	0.93	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.61	20.76	20.90	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.80	20.57	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.27	20.27	20.28	20.29	20.29	20.30	20.30	20.30	20.30	20.29	20.29	20.28	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.91	0.80	0.62	0.45	0.30	0.20	0.23	0.39	0.68	0.91	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.77	19.98	20.17	20.27	20.29	20.30	20.30	20.30	20.30	20.26	20.05	19.73	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.03	20.22	20.39	20.49	20.51	20.52	20.52	20.52	20.51	20.48	20.28	19.99	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.03	20.22	20.39	20.49	20.51	20.52	20.52	20.52	20.51	20.48	20.28	19.99	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.91	0.81	0.63	0.46	0.31	0.21	0.24	0.41	0.69	0.91	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	728.70	805.21	806.10	701.44	538.85	356.46	236.01	247.28	388.79	589.10	683.44	695.59	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	991.18	962.43	869.59	713.03	540.02	356.51	236.01	247.28	389.14	605.89	813.69	981.61	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	195.28	105.66	47.24	8.35	0.87	0.00	0.00	0.00	0.00	12.49	93.78	212.80	

∑(98)1...5, 10...12 = 676.47 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.35 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	676.47		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	710.29	(307a)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1937.41	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.48	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	123.53	(330a)

Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3119.99	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	710.29	x	4.24	x 0.01 =	30.12	(340a)
Water heating from boilers	1937.41	x	4.24	x 0.01 =	82.15	(342a)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		294.56	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.98	(357)
SAP value	86.30	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2718.38	x	0.216	=	587.17	(367)
Electrical energy for community heat distribution		26.48	x	0.519	=	13.74	(372)
Total CO2 associated with community systems						600.91	(373)
Total CO2 associated with space and water heating						600.91	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Total CO_2, kg/year					(376)..(382) =	846.03	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.44	(384)
EI value						91.00	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2718.38	x	1.22	=	3316.43	(367)
Electrical energy for community heat distribution		26.48	x	3.07	=	81.28	(372)
Total primary energy associated with community systems						3397.71	(373)
Total primary energy associated with space and water heating						3397.71	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Primary energy kWh/year						4847.64	(383)

Dwelling primary energy rate kWh/m2/year	59.85	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Gf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
Exposed floor			40.44	x	0.19	=	7.64			(28b
External wall			14.17	x	0.15	=	2.13			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			74.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.27 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.17 (36)
Total fabric heat loss	(33) + (36) =	45.44 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

63.02	62.81	62.59	61.53	61.31	60.25	60.25	60.04	60.68	61.31	61.74	62.17	

Average = ∑(39)1...12/12 = 61.47 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.78	0.78	0.77	0.76	0.76	0.74	0.74	0.74	0.75	0.76	0.76	0.77	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.83	0.66	0.49	0.34	0.24	0.27	0.44	0.72	0.93	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.61	20.76	20.90	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.80	20.57

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.27	20.27	20.28	20.29	20.29	20.30	20.30	20.30	20.30	20.29	20.29	20.28

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.91	0.80	0.62	0.45	0.30	0.20	0.23	0.39	0.68	0.91	0.97

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.77	19.98	20.17	20.27	20.29	20.30	20.30	20.30	20.30	20.26	20.05	19.73

(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.03	20.22	20.39	20.49	20.51	20.52	20.52	20.52	20.51	20.48	20.28	19.99

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.03	20.22	20.39	20.49	20.51	20.52	20.52	20.52	20.51	20.48	20.28	19.99

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.91	0.81	0.63	0.46	0.31	0.21	0.24	0.41	0.69	0.91	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	728.70	805.21	806.10	701.44	538.85	356.46	236.01	247.28	388.79	589.10	683.44	695.59	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	991.18	962.43	869.59	713.03	540.02	356.51	236.01	247.28	389.14	605.89	813.69	981.61	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	195.28	105.66	47.24	8.35	0.87	0.00	0.00	0.00	0.00	12.49	93.78	212.80	

∑(98)1...5, 10...12 = 676.47 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.35 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	676.47		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	142.06	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	568.23	(307b)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	387.48	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1549.93	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.48	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3119.99	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	142.06	x	2.97	x 0.01 =	4.22	(340a)
Space heating from boilers	568.23	x	4.24	x 0.01 =	24.09	(340b)
Water heating from CHP	387.48	x	2.97	x 0.01 =	11.51	(342a)
Water heating from boilers	1549.93	x	4.24	x 0.01 =	65.72	(342b)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		287.83	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.62	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	262.8560	x	0.2160	=	56.7769	(363)
less credit emissions for electricity		-87.1523	x	0.5190	=	-45.2320	(364)
Water heated by CHP		716.9746	x	0.2160	=	154.8665	(365)
less credit emissions for electricity		-237.7193	x	0.5190	=	-123.3763	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2174.71	x	0.216	=	469.74	(368)
Electrical energy for community heat distribution		26.48	x	0.519	=	13.74	(372)
Total CO2 associated with community systems						526.51	(373)
Total CO2 associated with space and water heating						526.51	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Total CO_2, kg/year					(376)..(382) =	771.63	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.53	(384)
EI value						91.79	
EI rating (section 14)						92	(385)

EI band | A

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	262.86	x	1.22	=	320.68	(363)
less credit energy for electricity		-87.15	x	3.07	=	-267.56	(364)
Water heated by CHP		716.97	x	1.22	=	874.71	(365)
less credit energy for electricity		-237.72	x	3.07	=	-729.80	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2174.71	x	1.22	=	2653.14	(368)
Electrical energy for community heat distribution		26.48	x	3.07	=	81.28	(372)
Total primary energy associated with community systems						2932.46	(373)
Total primary energy associated with space and water heating						2932.46	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Primary energy kWh/year						4382.39	(383)
Dwelling primary energy rate kWh/m2/year						54.10	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Gf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
Exposed floor			40.44	x	0.19	=	7.64			(28b
External wall			14.17	x	0.15	=	2.13			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			74.44							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.27 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.17 (36)
Total fabric heat loss	(33) + (36) =	45.44 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

63.02	62.81	62.59	61.53	61.31	60.25	60.25	60.04	60.68	61.31	61.74	62.17	

Average = ∑(39)1...12/12 = 61.47 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.78	0.78	0.77	0.76	0.76	0.74	0.74	0.74	0.75	0.76	0.76	0.77	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.83	0.66	0.49	0.34	0.24	0.27	0.44	0.72	0.93	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.61	20.76	20.90	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.80	20.57	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.27	20.27	20.28	20.29	20.29	20.30	20.30	20.30	20.30	20.29	20.29	20.28	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.91	0.80	0.62	0.45	0.30	0.20	0.23	0.39	0.68	0.91	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.77	19.98	20.17	20.27	20.29	20.30	20.30	20.30	20.30	20.26	20.05	19.73	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.03	20.22	20.39	20.49	20.51	20.52	20.52	20.52	20.51	20.48	20.28	19.99	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.03	20.22	20.39	20.49	20.51	20.52	20.52	20.52	20.51	20.48	20.28	19.99	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.91	0.81	0.63	0.46	0.31	0.21	0.24	0.41	0.69	0.91	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	728.70	805.21	806.10	701.44	538.85	356.46	236.01	247.28	388.79	589.10	683.44	695.59	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	991.18	962.43	869.59	713.03	540.02	356.51	236.01	247.28	389.14	605.89	813.69	981.61	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	195.28	105.66	47.24	8.35	0.87	0.00	0.00	0.00	0.00	12.49	93.78	212.80	

∑(98)1...5, 10...12 = 676.47 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.35 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	676.47		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	142.06	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	568.23	(307b)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	387.48	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1549.93	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	26.48	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2886.82	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	142.06	x	2.97	x 0.01 =	4.22	(340a)
Space heating from boilers	568.23	x	4.24	x 0.01 =	24.09	(340b)
Water heating from CHP	387.48	x	2.97	x 0.01 =	11.51	(342a)
Water heating from boilers	1549.93	x	4.24	x 0.01 =	65.72	(342b)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		287.83	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.62	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	262.8560	x	0.2160	=	56.7769	(363)
less credit emissions for electricity		-87.1523	x	0.5190	=	-45.2320	(364)
Water heated by CHP		716.9746	x	0.2160	=	154.8665	(365)
less credit emissions for electricity		-237.7193	x	0.5190	=	-123.3763	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2174.71	x	0.216	=	469.74	(368)
Electrical energy for community heat distribution		26.48	x	0.519	=	13.74	(372)
Total CO2 associated with community systems						526.51	(373)
Total CO2 associated with space and water heating						526.51	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)

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Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	650.61	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	8.03	(384)
EI value					93.08	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	262.86	x	1.22	=	320.68	(363)
less credit energy for electricity		-87.15	x	3.07	=	-267.56	(364)
Water heated by CHP		716.97	x	1.22	=	874.71	(365)
less credit energy for electricity		-237.72	x	3.07	=	-729.80	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2174.71	x	1.22	=	2653.14	(368)
Electrical energy for community heat distribution		26.48	x	3.07	=	81.28	(372)
Total primary energy associated with community systems						2932.46	(373)
Total primary energy associated with space and water heating						2932.46	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3666.54	(383)
Dwelling primary energy rate kWh/m2/year						45.27	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Go 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			14.17	x	0.15	=	2.13			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			34.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	26.63 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		5.10 (36)
Total fabric heat loss	(33) + (36) =	31.73 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)
Heat transfer coefficient, W/K (37)m + (38)m	49.31	49.10	48.88	47.82	47.61	46.54	46.54	46.33	46.97	47.61	48.03	48.46	

Average = ∑(39)1...12/12 = 47.77 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.61	0.61	0.60	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.59	0.60	

Average = ∑(40)1...12/12 = 0.59 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m	22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)
Primary circuit loss for each month from Table 3	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.84	0.70	0.52	0.38	0.26	0.19	0.21	0.34	0.58	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.85	20.94	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.95	20.83	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.42	20.42	20.43	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.82	0.67	0.50	0.35	0.24	0.16	0.18	0.31	0.55	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.24	20.35	20.41	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.38	20.21	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.42	20.53	20.59	20.61	20.61	20.62	20.62	20.62	20.62	20.61	20.56	20.40	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.42	20.53	20.59	20.61	20.61	20.62	20.62	20.62	20.62	20.61	20.56	20.40	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.82	0.68	0.51	0.36	0.24	0.17	0.19	0.32	0.56	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	695.71	728.39	680.02	559.30	424.29	280.24	187.16	195.65	306.13	475.34	615.74	670.25	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	795.07	767.59	688.71	559.98	424.32	280.24	187.16	195.65	306.14	476.59	646.37	785.09	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	73.93	26.34	6.46	0.49	0.02	0.00	0.00	0.00	0.00	0.93	22.06	85.44	

∑(98)1...5, 10...12 = 215.66 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.66 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	215.66		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	226.44	(307a)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1937.41	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	21.64	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)

Electricity for lighting (Appendix L)		348.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2636.15	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	226.44	x	4.24	x 0.01 =	9.60	(340a)
Water heating from boilers	1937.41	x	4.24	x 0.01 =	82.15	(342a)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		274.04	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.91	(357)
SAP value	87.26	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2221.62	x	0.216	=	479.87	(367)
Electrical energy for community heat distribution	21.64	x	0.519	=	11.23	(372)
Total CO2 associated with community systems					491.10	(373)
Total CO2 associated with space and water heating					491.10	(376)
Pumps and fans	123.53	x	0.519	=	64.11	(378)
Electricity for lighting	348.76	x	0.519	=	181.01	(379)
Total CO_2, kg/year				(376)..(382) =	736.22	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.09	(384)
EI value					92.17	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2221.62	x	1.22	=	2710.38	(367)
Electrical energy for community heat distribution	21.64	x	3.07	=	66.43	(372)
Total primary energy associated with community systems					2776.81	(373)
Total primary energy associated with space and water heating					2776.81	(376)
Pumps and fans	123.53	x	3.07	=	379.22	(378)
Electricity for lighting	348.76	x	3.07	=	1070.71	(379)
Primary energy kWh/year					4226.73	(383)
Dwelling primary energy rate kWh/m2/year					52.18	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Go 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			14.17	x	0.15	=	2.13			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			34.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	26.63 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		5.10 (36)
Total fabric heat loss	(33) + (36) =	31.73 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)
Heat transfer coefficient, W/K (37)m + (38)m	49.31	49.10	48.88	47.82	47.61	46.54	46.54	46.33	46.97	47.61	48.03	48.46	
Average = ∑(39)1...12/12 =												47.77	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.61	0.61	0.60	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.59	0.60	
Average = ∑(40)1...12/12 =												0.59	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	
∑(44)1...12 =												1117.64	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	
∑(45)1...12 =												1465.41	(45)
Distribution loss 0.15 x (45)m	22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)
Primary circuit loss for each month from Table 3	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.84	0.70	0.52	0.38	0.26	0.19	0.21	0.34	0.58	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.85	20.94	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.95	20.83	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.42	20.42	20.43	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.91	0.82	0.67	0.50	0.35	0.24	0.16	0.18	0.31	0.55	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.24	20.35	20.41	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.38	20.21	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.42	20.53	20.59	20.61	20.61	20.62	20.62	20.62	20.62	20.61	20.56	20.40	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.42	20.53	20.59	20.61	20.61	20.62	20.62	20.62	20.62	20.61	20.56	20.40	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.82	0.68	0.51	0.36	0.24	0.17	0.19	0.32	0.56	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	695.71	728.39	680.02	559.30	424.29	280.24	187.16	195.65	306.13	475.34	615.74	670.25	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	795.07	767.59	688.71	559.98	424.32	280.24	187.16	195.65	306.14	476.59	646.37	785.09	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	73.93	26.34	6.46	0.49	0.02	0.00	0.00	0.00	0.00	0.93	22.06	85.44	

∑(98)1...5, 10...12 = 215.66 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.66 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	215.66		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	45.29	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	181.16	(307b)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	387.48	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1549.93	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	21.64	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2636.15	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	45.29	x	2.97	x 0.01 =	1.35	(340a)
Space heating from boilers	181.16	x	4.24	x 0.01 =	7.68	(340b)
Water heating from CHP	387.48	x	2.97	x 0.01 =	11.51	(342a)
Water heating from boilers	1549.93	x	4.24	x 0.01 =	65.72	(342b)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		268.55	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.90	(357)
SAP value	87.51	
SAP rating (section 13)	88	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	83.7998	x	0.2160	=	18.1008	(363)
less credit emissions for electricity		-27.7846	x	0.5190	=	-14.4202	(364)
Water heated by CHP		716.9746	x	0.2160	=	154.8665	(365)
less credit emissions for electricity		-237.7193	x	0.5190	=	-123.3763	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1777.30	x	0.216	=	383.90	(368)
Electrical energy for community heat distribution		21.64	x	0.519	=	11.23	(372)
Total CO2 associated with community systems						430.30	(373)
Total CO2 associated with space and water heating						430.30	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Total CO_2, kg/year					(376)..(382) =	675.42	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	8.34	(384)
EI value						92.82	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	83.80	x	1.22	=	102.24	(363)
less credit energy for electricity		-27.78	x	3.07	=	-85.30	(364)
Water heated by CHP		716.97	x	1.22	=	874.71	(365)
less credit energy for electricity		-237.72	x	3.07	=	-729.80	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1777.30	x	1.22	=	2168.30	(368)
Electrical energy for community heat distribution		21.64	x	3.07	=	66.43	(372)
Total primary energy associated with community systems						2396.58	(373)
Total primary energy associated with space and water heating						2396.58	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Primary energy kWh/year						3846.51	(383)
Dwelling primary energy rate kWh/m2/year						47.49	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Go 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			14.17	x	0.15	=	2.13			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			34.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	26.63 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		5.10 (36)
Total fabric heat loss	(33) + (36) =	31.73 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)
Heat transfer coefficient, W/K (37)m + (38)m	49.31	49.10	48.88	47.82	47.61	46.54	46.54	46.33	46.97	47.61	48.03	48.46	

Average = ∑(39)1...12/12 = 47.77 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.61	0.61	0.60	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.59	0.60	

Average = ∑(40)1...12/12 = 0.59 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m	22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)
Primary circuit loss for each month from Table 3	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.84	0.70	0.52	0.38	0.26	0.19	0.21	0.34	0.58	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.85	20.94	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.95	20.83	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.42	20.42	20.43	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.44	20.43	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.91	0.82	0.67	0.50	0.35	0.24	0.16	0.18	0.31	0.55	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.24	20.35	20.41	20.44	20.44	20.45	20.45	20.46	20.45	20.44	20.38	20.21	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.42	20.53	20.59	20.61	20.61	20.62	20.62	20.62	20.62	20.61	20.56	20.40	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.42	20.53	20.59	20.61	20.61	20.62	20.62	20.62	20.62	20.61	20.56	20.40	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.82	0.68	0.51	0.36	0.24	0.17	0.19	0.32	0.56	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	695.71	728.39	680.02	559.30	424.29	280.24	187.16	195.65	306.13	475.34	615.74	670.25	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	795.07	767.59	688.71	559.98	424.32	280.24	187.16	195.65	306.14	476.59	646.37	785.09	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	73.93	26.34	6.46	0.49	0.02	0.00	0.00	0.00	0.00	0.93	22.06	85.44	

∑(98)1...5, 10...12 = 215.66 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.66 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	215.66		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	45.29	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	181.16	(307b)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	387.48	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1549.93	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	21.64	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2402.97	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	45.29	x	2.97	x 0.01 =	1.35	(340a)
Space heating from boilers	181.16	x	4.24	x 0.01 =	7.68	(340b)
Water heating from CHP	387.48	x	2.97	x 0.01 =	11.51	(342a)
Water heating from boilers	1549.93	x	4.24	x 0.01 =	65.72	(342b)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		268.55	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.90	(357)
SAP value	87.51	
SAP rating (section 13)	88	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	83.7998	x	0.2160	=	18.1008	(363)
less credit emissions for electricity		-27.7846	x	0.5190	=	-14.4202	(364)
Water heated by CHP		716.9746	x	0.2160	=	154.8665	(365)
less credit emissions for electricity		-237.7193	x	0.5190	=	-123.3763	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1777.30	x	0.216	=	383.90	(368)
Electrical energy for community heat distribution		21.64	x	0.519	=	11.23	(372)
Total CO2 associated with community systems						430.30	(373)
Total CO2 associated with space and water heating						430.30	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	554.40	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	6.84	(384)
EI value					94.10	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	83.80	x	1.22	=	102.24	(363)
less credit energy for electricity		-27.78	x	3.07	=	-85.30	(364)
Water heated by CHP		716.97	x	1.22	=	874.71	(365)
less credit energy for electricity		-237.72	x	3.07	=	-729.80	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1777.30	x	1.22	=	2168.30	(368)
Electrical energy for community heat distribution		21.64	x	3.07	=	66.43	(372)
Total primary energy associated with community systems						2396.58	(373)
Total primary energy associated with space and water heating						2396.58	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3130.65	(383)
Dwelling primary energy rate kWh/m2/year						38.65	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	GoE 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			39.17	x	0.15	=	5.88			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			59.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.38 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.85 (36)
Total fabric heat loss	(33) + (36) =	39.23 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.81	56.60	56.38	55.32	55.11	54.04	54.04	53.83	54.47	55.11	55.53	55.96	

Average = ∑(39)1...12/12 = 55.27 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.70	0.70	0.70	0.68	0.68	0.67	0.67	0.66	0.67	0.68	0.69	0.69	

Average = ∑(40)1...12/12 = 0.68 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.90	0.78	0.60	0.44	0.30	0.22	0.24	0.39	0.66	0.90	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.72	20.85	20.95	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.69	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.34	20.34	20.34	20.36	20.36	20.37	20.37	20.37	20.37	20.36	20.35	20.35	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.95	0.88	0.75	0.57	0.41	0.27	0.18	0.21	0.36	0.63	0.88	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.99	20.17	20.29	20.35	20.36	20.37	20.37	20.37	20.37	20.35	20.21	19.95	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.21	20.38	20.49	20.55	20.56	20.56	20.56	20.57	20.56	20.55	20.42	20.18	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.21	20.38	20.49	20.55	20.56	20.56	20.56	20.57	20.56	20.55	20.42	20.18	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.94	0.88	0.76	0.58	0.42	0.28	0.19	0.22	0.37	0.64	0.88	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	718.72	779.58	757.84	640.27	487.68	322.29	214.22	224.23	351.81	541.53	660.98	688.15	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	904.00	875.97	789.02	644.33	487.99	322.30	214.22	224.23	351.89	548.04	739.49	894.19	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	137.85	64.77	23.20	2.92	0.23	0.00	0.00	0.00	0.00	4.84	56.53	153.30	

∑(98)1...5, 10...12 = 443.64 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.48 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	443.64		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	465.82	(307a)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1937.41	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.03	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)

Electricity for lighting (Appendix L)		348.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2875.52	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	465.82	x	4.24	x 0.01 =	19.75	(340a)
Water heating from boilers	1937.41	x	4.24	x 0.01 =	82.15	(342a)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		284.19	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.95	(357)
SAP value	86.79	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2467.39	x	0.216	=	532.96	(367)
Electrical energy for community heat distribution		24.03	x	0.519	=	12.47	(372)
Total CO2 associated with community systems						545.43	(373)
Total CO2 associated with space and water heating						545.43	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Total CO_2, kg/year					(376)..(382) =	790.55	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.76	(384)
EI value						91.59	
EI rating (section 14)						92	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2467.39	x	1.22	=	3010.21	(367)
Electrical energy for community heat distribution		24.03	x	3.07	=	73.78	(372)
Total primary energy associated with community systems						3083.99	(373)
Total primary energy associated with space and water heating						3083.99	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Primary energy kWh/year						4533.92	(383)
Dwelling primary energy rate kWh/m2/year						55.97	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	GoE 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			39.17	x	0.15	=	5.88			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			59.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.38 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.85 (36)
Total fabric heat loss	(33) + (36) =	39.23 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.81	56.60	56.38	55.32	55.11	54.04	54.04	53.83	54.47	55.11	55.53	55.96	

Average = ∑(39)1...12/12 = 55.27 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.70	0.70	0.70	0.68	0.68	0.67	0.67	0.66	0.67	0.68	0.69	0.69	

Average = ∑(40)1...12/12 = 0.68 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.90	0.78	0.60	0.44	0.30	0.22	0.24	0.39	0.66	0.90	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.72	20.85	20.95	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.69	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.34	20.34	20.34	20.36	20.36	20.37	20.37	20.37	20.37	20.36	20.35	20.35	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.95	0.88	0.75	0.57	0.41	0.27	0.18	0.21	0.36	0.63	0.88	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.99	20.17	20.29	20.35	20.36	20.37	20.37	20.37	20.37	20.35	20.21	19.95	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.21	20.38	20.49	20.55	20.56	20.56	20.56	20.57	20.56	20.55	20.42	20.18	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.21	20.38	20.49	20.55	20.56	20.56	20.56	20.57	20.56	20.55	20.42	20.18	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.94	0.88	0.76	0.58	0.42	0.28	0.19	0.22	0.37	0.64	0.88	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	718.72	779.58	757.84	640.27	487.68	322.29	214.22	224.23	351.81	541.53	660.98	688.15	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	904.00	875.97	789.02	644.33	487.99	322.30	214.22	224.23	351.89	548.04	739.49	894.19	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	137.85	64.77	23.20	2.92	0.23	0.00	0.00	0.00	0.00	4.84	56.53	153.30	

∑(98)1...5, 10...12 = 443.64 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.48 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	443.64		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	93.16	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	372.66	(307b)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	387.48	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1549.93	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.03	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2875.52	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	93.16	x	2.97	x 0.01 =	2.77	(340a)
Space heating from boilers	372.66	x	4.24	x 0.01 =	15.80	(340b)
Water heating from CHP	387.48	x	2.97	x 0.01 =	11.51	(342a)
Water heating from boilers	1549.93	x	4.24	x 0.01 =	65.72	(342b)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		278.09	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.93	(357)
SAP value	87.07	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	172.3860	x	0.2160	=	37.2354	(363)
less credit emissions for electricity		-57.1561	x	0.5190	=	-29.6640	(364)
Water heated by CHP		716.9746	x	0.2160	=	154.8665	(365)
less credit emissions for electricity		-237.7193	x	0.5190	=	-123.3763	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1973.91	x	0.216	=	426.36	(368)
Electrical energy for community heat distribution		24.03	x	0.519	=	12.47	(372)
Total CO2 associated with community systems						477.90	(373)
Total CO2 associated with space and water heating						477.90	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Total CO_2, kg/year					(376)..(382) =	723.02	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	8.93	(384)
EI value						92.31	
EI rating (section 14)						92	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	172.39	x	1.22	=	210.31	(363)
less credit energy for electricity		-57.16	x	3.07	=	-175.47	(364)
Water heated by CHP		716.97	x	1.22	=	874.71	(365)
less credit energy for electricity		-237.72	x	3.07	=	-729.80	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1973.91	x	1.22	=	2408.17	(368)
Electrical energy for community heat distribution		24.03	x	3.07	=	73.78	(372)
Total primary energy associated with community systems						2661.70	(373)
Total primary energy associated with space and water heating						2661.70	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Primary energy kWh/year						4111.63	(383)
Dwelling primary energy rate kWh/m2/year						50.76	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	GoE 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			39.17	x	0.15	=	5.88			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			59.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.38 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.85 (36)
Total fabric heat loss	(33) + (36) =	39.23 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.81	56.60	56.38	55.32	55.11	54.04	54.04	53.83	54.47	55.11	55.53	55.96	

Average = ∑(39)1...12/12 = 55.27 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.70	0.70	0.70	0.68	0.68	0.67	0.67	0.66	0.67	0.68	0.69	0.69	

Average = ∑(40)1...12/12 = 0.68 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.90	0.78	0.60	0.44	0.30	0.22	0.24	0.39	0.66	0.90	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.72	20.85	20.95	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.69	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.34	20.34	20.34	20.36	20.36	20.37	20.37	20.37	20.37	20.36	20.35	20.35	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.95	0.88	0.75	0.57	0.41	0.27	0.18	0.21	0.36	0.63	0.88	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.99	20.17	20.29	20.35	20.36	20.37	20.37	20.37	20.37	20.35	20.21	19.95	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.21	20.38	20.49	20.55	20.56	20.56	20.56	20.57	20.56	20.55	20.42	20.18	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.21	20.38	20.49	20.55	20.56	20.56	20.56	20.57	20.56	20.55	20.42	20.18	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.94	0.88	0.76	0.58	0.42	0.28	0.19	0.22	0.37	0.64	0.88	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	718.72	779.58	757.84	640.27	487.68	322.29	214.22	224.23	351.81	541.53	660.98	688.15	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	904.00	875.97	789.02	644.33	487.99	322.30	214.22	224.23	351.89	548.04	739.49	894.19	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	137.85	64.77	23.20	2.92	0.23	0.00	0.00	0.00	0.00	4.84	56.53	153.30	

∑(98)1...5, 10...12 = 443.64 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.48 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	443.64		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	93.16	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	372.66	(307b)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	387.48	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1549.93	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.03	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2642.35	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	93.16	x	2.97	x 0.01 =	2.77	(340a)
Space heating from boilers	372.66	x	4.24	x 0.01 =	15.80	(340b)
Water heating from CHP	387.48	x	2.97	x 0.01 =	11.51	(342a)
Water heating from boilers	1549.93	x	4.24	x 0.01 =	65.72	(342b)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		278.09	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.93	(357)
SAP value	87.07	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	172.3860	x	0.2160	=	37.2354	(363)
less credit emissions for electricity		-57.1561	x	0.5190	=	-29.6640	(364)
Water heated by CHP		716.9746	x	0.2160	=	154.8665	(365)
less credit emissions for electricity		-237.7193	x	0.5190	=	-123.3763	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1973.91	x	0.216	=	426.36	(368)
Electrical energy for community heat distribution		24.03	x	0.519	=	12.47	(372)
Total CO2 associated with community systems						477.90	(373)
Total CO2 associated with space and water heating						477.90	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	602.00	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.43	(384)
EI value					93.60	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	172.39	x	1.22	=	210.31	(363)
less credit energy for electricity		-57.16	x	3.07	=	-175.47	(364)
Water heated by CHP		716.97	x	1.22	=	874.71	(365)
less credit energy for electricity		-237.72	x	3.07	=	-729.80	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1973.91	x	1.22	=	2408.17	(368)
Electrical energy for community heat distribution		24.03	x	3.07	=	73.78	(372)
Total primary energy associated with community systems						2661.70	(373)
Total primary energy associated with space and water heating						2661.70	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3395.78	(383)
Dwelling primary energy rate kWh/m2/year						41.92	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	GrE 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			39.17	x	0.15	=	5.88			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Roof			81.00	x	0.12	=	9.72			(30)
Total area of external elements ∑A, m²			140.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.10 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		21.00 (36)
Total fabric heat loss	(33) + (36) =	61.10 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

78.68	78.47	78.25	77.19	76.98	75.91	75.91	75.70	76.34	76.98	77.40	77.83	

Average = ∑(39)1...12/12 = 77.14 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.97	0.97	0.97	0.95	0.95	0.94	0.94	0.93	0.94	0.95	0.96	0.96	

Average = ∑(40)1...12/12 = 0.95 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.77	0.60	0.42	0.30	0.34	0.54	0.83	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.32	20.50	20.72	20.91	20.98	21.00	21.00	21.00	20.99	20.88	20.58	20.28	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.11	20.11	20.11	20.12	20.12	20.14	20.14	20.14	20.13	20.12	20.12	20.12	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.88	0.73	0.55	0.36	0.24	0.27	0.48	0.79	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.23	19.49	19.78	20.03	20.11	20.13	20.14	20.14	20.13	20.01	19.60	19.18	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.56	19.80	20.07	20.30	20.38	20.40	20.40	20.40	20.39	20.28	19.90	19.52	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.56	19.80	20.07	20.30	20.38	20.40	20.40	20.40	20.39	20.28	19.90	19.52	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.88	0.74	0.56	0.38	0.26	0.29	0.50	0.79	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	739.72	836.42	877.13	820.20	657.16	439.43	288.55	302.91	476.31	673.53	710.41	703.51	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1201.00	1169.32	1062.04	879.68	667.96	440.34	288.62	303.06	480.37	744.92	990.88	1192.22	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	343.19	223.71	137.57	42.83	8.04	0.00	0.00	0.00	0.00	53.12	201.94	363.60	

∑(98)1...5, 10...12 = 1373.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.96 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1373.99		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1442.69	(307a)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1937.41	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	33.80	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	123.53	(330a)

Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3852.39	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1442.69	x	4.24	x 0.01 =	61.17	(340a)
Water heating from boilers	1937.41	x	4.24	x 0.01 =	82.15	(342a)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		325.61	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.09	(357)
SAP value	84.86	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3470.33	x	0.216	=	749.59	(367)
Electrical energy for community heat distribution		33.80	x	0.519	=	17.54	(372)
Total CO2 associated with community systems						767.13	(373)
Total CO2 associated with space and water heating						767.13	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Total CO_2, kg/year					(376)..(382) =	1012.25	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.50	(384)
EI value						89.23	
EI rating (section 14)						89	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3470.33	x	1.22	=	4233.80	(367)
Electrical energy for community heat distribution		33.80	x	3.07	=	103.77	(372)
Total primary energy associated with community systems						4337.57	(373)
Total primary energy associated with space and water heating						4337.57	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Primary energy kWh/year						5787.50	(383)

Dwelling primary energy rate kWh/m2/year	71.45	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	GrE 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			39.17	x	0.15	=	5.88			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Roof			81.00	x	0.12	=	9.72			(30)
Total area of external elements ∑A, m²			140.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.10 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		21.00 (36)
Total fabric heat loss	(33) + (36) =	61.10 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

78.68	78.47	78.25	77.19	76.98	75.91	75.91	75.70	76.34	76.98	77.40	77.83	

Average = ∑(39)1...12/12 = 77.14 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.97	0.97	0.97	0.95	0.95	0.94	0.94	0.93	0.94	0.95	0.96	0.96	

Average = ∑(40)1...12/12 = 0.95 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.77	0.60	0.42	0.30	0.34	0.54	0.83	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.32	20.50	20.72	20.91	20.98	21.00	21.00	21.00	20.99	20.88	20.58	20.28	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.11	20.11	20.11	20.12	20.12	20.14	20.14	20.14	20.13	20.12	20.12	20.12	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.88	0.73	0.55	0.36	0.24	0.27	0.48	0.79	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.23	19.49	19.78	20.03	20.11	20.13	20.14	20.14	20.13	20.01	19.60	19.18	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.56	19.80	20.07	20.30	20.38	20.40	20.40	20.40	20.39	20.28	19.90	19.52	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.56	19.80	20.07	20.30	20.38	20.40	20.40	20.40	20.39	20.28	19.90	19.52	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.88	0.74	0.56	0.38	0.26	0.29	0.50	0.79	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	739.72	836.42	877.13	820.20	657.16	439.43	288.55	302.91	476.31	673.53	710.41	703.51	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1201.00	1169.32	1062.04	879.68	667.96	440.34	288.62	303.06	480.37	744.92	990.88	1192.22	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	343.19	223.71	137.57	42.83	8.04	0.00	0.00	0.00	0.00	53.12	201.94	363.60	

∑(98)1...5, 10...12 = 1373.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.96 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1373.99		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	288.54	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1154.15	(307b)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	387.48	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1549.93	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	33.80	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3852.39	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	288.54	x	2.97	x 0.01 =	8.57	(340a)
Space heating from boilers	1154.15	x	4.24	x 0.01 =	48.94	(340b)
Water heating from CHP	387.48	x	2.97	x 0.01 =	11.51	(342a)
Water heating from boilers	1549.93	x	4.24	x 0.01 =	65.72	(342b)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		317.03	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.06	(357)
SAP value	85.26	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	533.8927	x	0.2160	=	115.3208	(363)
less credit emissions for electricity		-177.0169	x	0.5190	=	-91.8718	(364)
Water heated by CHP		716.9746	x	0.2160	=	154.8665	(365)
less credit emissions for electricity		-237.7193	x	0.5190	=	-123.3763	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2776.26	x	0.216	=	599.67	(368)
Electrical energy for community heat distribution		33.80	x	0.519	=	17.54	(372)
Total CO2 associated with community systems						672.15	(373)
Total CO2 associated with space and water heating						672.15	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)
Total CO_2, kg/year					(376)..(382) =	917.27	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.32	(384)
EI value						90.24	
EI rating (section 14)						90	(385)

EI band | B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	533.89	x	1.22	=	651.35	(363)
less credit energy for electricity		-177.02	x	3.07	=	-543.44	(364)
Water heated by CHP		716.97	x	1.22	=	874.71	(365)
less credit energy for electricity		-237.72	x	3.07	=	-729.80	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2776.26	x	1.22	=	3387.04	(368)
Electrical energy for community heat distribution		33.80	x	3.07	=	103.77	(372)
Total primary energy associated with community systems						3743.63	(373)
Total primary energy associated with space and water heating						3743.63	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Primary energy kWh/year						5193.56	(383)
Dwelling primary energy rate kWh/m2/year						64.12	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	GrE 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		81.00	(1a) x	2.50	(2a) =	202.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	81.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	202.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.83	x	1.24	=	24.50			(27)
External wall			39.17	x	0.15	=	5.88			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Roof			81.00	x	0.12	=	9.72			(30)
Total area of external elements ∑A, m²			140.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.10 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		21.00 (36)
Total fabric heat loss	(33) + (36) =	61.10 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.58	17.37	17.15	16.09	15.88	14.81	14.81	14.60	15.24	15.88	16.30	16.73	(38)

Heat transfer coefficient, W/K (37)m + (38)m

78.68	78.47	78.25	77.19	76.98	75.91	75.91	75.70	76.34	76.98	77.40	77.83	

Average = ∑(39)1...12/12 = 77.14 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.97	0.97	0.97	0.95	0.95	0.94	0.94	0.93	0.94	0.95	0.96	0.96	

Average = ∑(40)1...12/12 = 0.95 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.48 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		93.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.45	98.73	95.00	91.27	87.55	83.82	83.82	87.55	91.27	95.00	98.73	102.45	

∑(44)1...12 = 1117.64 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

151.93	132.88	137.12	119.55	114.71	98.98	91.72	105.25	106.51	124.13	135.49	147.14	

∑(45)1...12 = 1465.41 (45)

Distribution loss 0.15 x (45)m

22.79	19.93	20.57	17.93	17.21	14.85	13.76	15.79	15.98	18.62	20.32	22.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

184.18	162.01	169.37	150.76	146.96	130.19	123.97	137.50	137.72	156.38	166.71	179.39	

∑(64)1...12 = 1845.15 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

76.32	67.49	71.39	64.72	63.94	57.88	56.30	60.80	60.38	67.07	70.02	74.73	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	148.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	49.37	43.85	35.66	27.00	20.18	17.04	18.41	23.93	32.12	40.78	47.60	50.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	330.62	334.05	325.41	307.00	283.77	261.93	247.35	243.91	252.56	270.97	294.20	316.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	52.37	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	-99.26	(71)
Water heating gains (Table 5)	102.58	100.43	95.96	89.89	85.94	80.39	75.67	81.72	83.87	90.15	97.25	100.44	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	584.58	580.34	559.03	525.89	491.90	461.36	443.43	451.57	470.55	503.90	541.05	569.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	13.37	x	36.79	x 0.9 x	0.50	x	0.90	=	153.41	(79)
NorthEast	0.77	x	6.46	x	11.28	x 0.9 x	0.50	x	0.90	=	22.73	(75)

Solar gains in watts ∑(74)m...(82)m

176.14	307.58	440.90	579.91	680.23	688.81	658.47	581.56	488.72	345.35	212.35	149.85	(83)

Total gains - internal and solar (73)m + (83)m

760.72	887.92	999.93	1105.80	1172.13	1150.17	1101.89	1033.13	959.26	849.25	753.40	719.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.77	0.60	0.42	0.30	0.34	0.54	0.83	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.32	20.50	20.72	20.91	20.98	21.00	21.00	21.00	20.99	20.88	20.58	20.28	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.11	20.11	20.11	20.12	20.12	20.14	20.14	20.14	20.13	20.12	20.12	20.12	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.88	0.73	0.55	0.36	0.24	0.27	0.48	0.79	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.23	19.49	19.78	20.03	20.11	20.13	20.14	20.14	20.13	20.01	19.60	19.18	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.56	19.80	20.07	20.30	20.38	20.40	20.40	20.40	20.39	20.28	19.90	19.52	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.56	19.80	20.07	20.30	20.38	20.40	20.40	20.40	20.39	20.28	19.90	19.52	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.88	0.74	0.56	0.38	0.26	0.29	0.50	0.79	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	739.72	836.42	877.13	820.20	657.16	439.43	288.55	302.91	476.31	673.53	710.41	703.51	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1201.00	1169.32	1062.04	879.68	667.96	440.34	288.62	303.06	480.37	744.92	990.88	1192.22	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	343.19	223.71	137.57	42.83	8.04	0.00	0.00	0.00	0.00	53.12	201.94	363.60	

∑(98)1...5, 10...12 = 1373.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.96 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1373.99		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	288.54	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1154.15	(307b)

Water heating

Annual water heating requirement	1845.15		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	387.48	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1549.93	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	33.80	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	123.53		(330a)
Total electricity for the above, kWh/year		123.53	(331)
Electricity for lighting (Appendix L)		348.76	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3619.21	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	288.54	x	2.97	x 0.01 =	8.57	(340a)
Space heating from boilers	1154.15	x	4.24	x 0.01 =	48.94	(340b)
Water heating from CHP	387.48	x	2.97	x 0.01 =	11.51	(342a)
Water heating from boilers	1549.93	x	4.24	x 0.01 =	65.72	(342b)
Pumps and fans	123.53	x	13.19	x 0.01 =	16.29	(349)
Electricity for lighting	348.76	x	13.19	x 0.01 =	46.00	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		317.03	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.06	(357)
SAP value	85.26	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	533.8927	x	0.2160	=	115.3208	(363)
less credit emissions for electricity		-177.0169	x	0.5190	=	-91.8718	(364)
Water heated by CHP		716.9746	x	0.2160	=	154.8665	(365)
less credit emissions for electricity		-237.7193	x	0.5190	=	-123.3763	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2776.26	x	0.216	=	599.67	(368)
Electrical energy for community heat distribution		33.80	x	0.519	=	17.54	(372)
Total CO2 associated with community systems						672.15	(373)
Total CO2 associated with space and water heating						672.15	(376)
Pumps and fans		123.53	x	0.519	=	64.11	(378)
Electricity for lighting		348.76	x	0.519	=	181.01	(379)

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Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	796.25	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.83	(384)
EI value					91.53	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	533.89	x	1.22	=	651.35	(363)
less credit energy for electricity		-177.02	x	3.07	=	-543.44	(364)
Water heated by CHP		716.97	x	1.22	=	874.71	(365)
less credit energy for electricity		-237.72	x	3.07	=	-729.80	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2776.26	x	1.22	=	3387.04	(368)
Electrical energy for community heat distribution		33.80	x	3.07	=	103.77	(372)
Total primary energy associated with community systems						3743.63	(373)
Total primary energy associated with space and water heating						3743.63	(376)
Pumps and fans		123.53	x	3.07	=	379.22	(378)
Electricity for lighting		348.76	x	3.07	=	1070.71	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						4477.70	(383)
Dwelling primary energy rate kWh/m2/year						55.28	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Hf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
Exposed floor			50.00	x	0.19	=	9.45			(28b
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			90.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	27.45 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.50 (36)
Total fabric heat loss	(33) + (36) =	40.95 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	51.80	51.67	51.54	50.88	50.75	50.09	50.09	49.96	50.35	50.75	51.01	51.27	
Average = ∑(39)1...12/12 =												50.85	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.04	1.03	1.03	1.02	1.01	1.00	1.00	1.00	1.01	1.01	1.02	1.03	
Average = ∑(40)1...12/12 =												1.02	(40)
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	
∑(44)1...12 =												892.08	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
∑(45)1...12 =												1169.66	(45)
Distribution loss 0.15 x (45)m													
	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss for each month from Table 3a, 3b or 3c

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

	153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69 (62)

Solar DHW input calculated using Appendix G or Appendix H

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (63)

Output from water heater for each month (kWh/month) (62)m + (63)m

	153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

	66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

	120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34 (83)

Total gains - internal and solar (73)m + (83)m

	543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.89	0.80	0.66	0.49	0.35	0.37	0.55	0.80	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.35	20.52	20.70	20.87	20.96	20.99	21.00	21.00	20.99	20.88	20.60	20.31

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.05	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.08	20.07	20.07	20.06

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.93	0.87	0.76	0.61	0.42	0.28	0.30	0.48	0.76	0.92	0.97

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.23	19.47	19.71	19.93	20.04	20.08	20.08	20.08	20.07	19.96	19.59	19.18

(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.80	20.01	20.22	20.41	20.51	20.55	20.55	20.55	20.54	20.43	20.11	19.76

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.80	20.01	20.22	20.41	20.51	20.55	20.55	20.55	20.54	20.43	20.11	19.76

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.96	0.93	0.87	0.78	0.63	0.45	0.31	0.33	0.52	0.77	0.92	0.97
(94)												
Useful gains, ηmGm, W (94)m x (84)m	520.53	572.43	577.90	529.36	431.21	295.89	197.72	207.15	319.99	451.73	494.07	498.42
(95)												
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
(96)												
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	802.99	780.45	706.91	585.57	447.04	297.89	197.92	207.44	324.26	498.96	663.67	797.76
(97)												
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	210.15	139.79	95.98	40.47	11.78	0.00	0.00	0.00	0.00	35.14	122.11	222.71

∑(98)1...5, 10...12 = 878.13 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.56 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	878.13		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	922.03	(307a)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1626.87	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.49	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2856.96	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	922.03	x	4.24	x 0.01 =	39.09	(340a)
Water heating from boilers	1626.87	x	4.24	x 0.01 =	68.98	(342a)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		268.71	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.43	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2616.94	x	0.216	=	565.26	(367)
Electrical energy for community heat distribution	25.49	x	0.519	=	13.23	(372)
Total CO2 associated with community systems					578.49	(373)
Total CO2 associated with space and water heating					578.49	(376)
Pumps and fans	76.25	x	0.519	=	39.57	(378)
Electricity for lighting	231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year				(376)..(382) =	738.37	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	14.77	(384)
EI value					89.59	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2616.94	x	1.22	=	3192.67	(367)
Electrical energy for community heat distribution	25.49	x	3.07	=	78.25	(372)
Total primary energy associated with community systems					3270.92	(373)
Total primary energy associated with space and water heating					3270.92	(376)
Pumps and fans	76.25	x	3.07	=	234.09	(378)
Electricity for lighting	231.81	x	3.07	=	711.66	(379)

Primary energy kWh/year	4216.67	(383)
Dwelling primary energy rate kWh/m2/year	84.33	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Hf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
Exposed floor			50.00	x	0.19	=	9.45			(28b
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			90.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	27.45 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.50 (36)
Total fabric heat loss	(33) + (36) =	40.95 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	51.80	51.67	51.54	50.88	50.75	50.09	50.09	49.96	50.35	50.75	51.01	51.27	
										Average = ∑(39)1...12/12 =		50.85	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.04	1.03	1.03	1.02	1.01	1.00	1.00	1.00	1.01	1.01	1.02	1.03	
										Average = ∑(40)1...12/12 =		1.02	(40)
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	
											∑(44)1...12 =	892.08	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
											∑(45)1...12 =	1169.66	(45)
Distribution loss 0.15 x (45)m													
	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34	(83)

Total gains - internal and solar (73)m + (83)m

543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.89	0.80	0.66	0.49	0.35	0.37	0.55	0.80	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.35	20.52	20.70	20.87	20.96	20.99	21.00	21.00	20.99	20.88	20.60	20.31

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.05	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.08	20.07	20.07	20.06

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.93	0.87	0.76	0.61	0.42	0.28	0.30	0.48	0.76	0.92	0.97

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.23	19.47	19.71	19.93	20.04	20.08	20.08	20.08	20.07	19.96	19.59	19.18

(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.80	20.01	20.22	20.41	20.51	20.55	20.55	20.55	20.54	20.43	20.11	19.76

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.80	20.01	20.22	20.41	20.51	20.55	20.55	20.55	20.54	20.43	20.11	19.76

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.96	0.93	0.87	0.78	0.63	0.45	0.31	0.33	0.52	0.77	0.92	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	520.53	572.43	577.90	529.36	431.21	295.89	197.72	207.15	319.99	451.73	494.07	498.42	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	802.99	780.45	706.91	585.57	447.04	297.89	197.92	207.44	324.26	498.96	663.67	797.76	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	210.15	139.79	95.98	40.47	11.78	0.00	0.00	0.00	0.00	35.14	122.11	222.71	

∑(98)1...5, 10...12 = 878.13 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.56 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	878.13		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	184.41	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	737.63	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.49	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	76.25	(330a)
Total electricity for the above, kWh/year	76.25	(331)
Electricity for lighting (Appendix L)	231.81	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2856.96	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	184.41	x	2.97	x 0.01 =	5.48	(340a)
Space heating from boilers	737.63	x	4.24	x 0.01 =	31.28	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		262.23	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.16	(357)
SAP value	83.83	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	341.2145	x	0.2160	=	73.7023	(363)
less credit emissions for electricity		-113.1327	x	0.5190	=	-58.7159	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2093.56	x	0.216	=	452.21	(368)
Electrical energy for community heat distribution		25.49	x	0.519	=	13.23	(372)
Total CO2 associated with community systems						506.87	(373)
Total CO2 associated with space and water heating						506.87	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year					(376)..(382) =	666.75	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	13.33	(384)
EI value						90.60	

EI rating (section 14)	91	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	341.21	x	1.22	=	416.28	(363)
less credit energy for electricity		-113.13	x	3.07	=	-347.32	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2093.56	x	1.22	=	2554.14	(368)
Electrical energy for community heat distribution		25.49	x	3.07	=	78.25	(372)
Total primary energy associated with community systems						2823.04	(373)
Total primary energy associated with space and water heating						2823.04	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year						3768.78	(383)
Dwelling primary energy rate kWh/m2/year						75.38	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Hf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
Exposed floor			50.00	x	0.19	=	9.45			(28b
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			90.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	27.45 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.50 (36)
Total fabric heat loss	(33) + (36) =	40.95 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)
Heat transfer coefficient, W/K (37)m + (38)m	51.80	51.67	51.54	50.88	50.75	50.09	50.09	49.96	50.35	50.75	51.01	51.27	

Average = ∑(39)1...12/12 = 50.85 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.04	1.03	1.03	1.02	1.01	1.00	1.00	1.00	1.01	1.01	1.02	1.03	

Average = ∑(40)1...12/12 = 1.02 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34	(83)

Total gains - internal and solar (73)m + (83)m

543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.89	0.80	0.66	0.49	0.35	0.37	0.55	0.80	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.35	20.52	20.70	20.87	20.96	20.99	21.00	21.00	20.99	20.88	20.60	20.31

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.05	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.08	20.07	20.07	20.06

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.93	0.87	0.76	0.61	0.42	0.28	0.30	0.48	0.76	0.92	0.97

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.23	19.47	19.71	19.93	20.04	20.08	20.08	20.08	20.07	19.96	19.59	19.18

(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.80	20.01	20.22	20.41	20.51	20.55	20.55	20.55	20.54	20.43	20.11	19.76

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.80	20.01	20.22	20.41	20.51	20.55	20.55	20.55	20.54	20.43	20.11	19.76

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.93	0.87	0.78	0.63	0.45	0.31	0.33	0.52	0.77	0.92	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	520.53	572.43	577.90	529.36	431.21	295.89	197.72	207.15	319.99	451.73	494.07	498.42	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	802.99	780.45	706.91	585.57	447.04	297.89	197.92	207.44	324.26	498.96	663.67	797.76	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	210.15	139.79	95.98	40.47	11.78	0.00	0.00	0.00	0.00	35.14	122.11	222.71	

∑(98)1...5, 10...12 = 878.13 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.56 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	878.13		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	184.41	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	737.63	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.49	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2623.79	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	184.41	x	2.97	x 0.01 =	5.48	(340a)
Space heating from boilers	737.63	x	4.24	x 0.01 =	31.28	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		262.23	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.16	(357)
SAP value	83.83	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	341.2145	x	0.2160	=	73.7023	(363)
less credit emissions for electricity		-113.1327	x	0.5190	=	-58.7159	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2093.56	x	0.216	=	452.21	(368)
Electrical energy for community heat distribution		25.49	x	0.519	=	13.23	(372)
Total CO2 associated with community systems						506.87	(373)
Total CO2 associated with space and water heating						506.87	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)

Electricity for lighting	231.81	x	0.519	=	120.31	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	545.73	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.91	(384)
EI value					92.30	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	341.21	x	1.22	=	416.28	(363)
less credit energy for electricity		-113.13	x	3.07	=	-347.32	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2093.56	x	1.22	=	2554.14	(368)
Electrical energy for community heat distribution		25.49	x	3.07	=	78.25	(372)
Total primary energy associated with community systems						2823.04	(373)
Total primary energy associated with space and water heating						2823.04	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3052.92	(383)
Dwelling primary energy rate kWh/m2/year						61.06	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ho 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			40.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.00 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.00 (36)
Total fabric heat loss	(33) + (36) =	24.00 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

34.85	34.72	34.59	33.93	33.80	33.14	33.14	33.01	33.40	33.80	34.06	34.32	

Average = ∑(39)1...12/12 = 33.90 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.70	0.69	0.69	0.68	0.68	0.66	0.66	0.66	0.67	0.68	0.68	0.69	

Average = ∑(40)1...12/12 = 0.68 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34	(83)

Total gains - internal and solar (73)m + (83)m

543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.91	0.84	0.73	0.60	0.46	0.33	0.23	0.24	0.37	0.60	0.82	0.93	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.82	20.91	20.97	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.94	20.80	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.34	20.35	20.35	20.36	20.36	20.37	20.37	20.38	20.37	20.36	20.36	20.35	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.90	0.81	0.71	0.57	0.43	0.29	0.20	0.21	0.34	0.56	0.80	0.91	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.13	20.24	20.31	20.35	20.36	20.37	20.37	20.38	20.37	20.36	20.29	20.11	(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.48	20.59	20.65	20.68	20.69	20.69	20.69	20.70	20.69	20.68	20.62	20.46	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.48	20.59	20.65	20.68	20.69	20.69	20.69	20.70	20.69	20.68	20.62	20.46	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.90	0.82	0.72	0.58	0.45	0.31	0.22	0.23	0.36	0.58	0.81	0.92	(94)
Useful gains, ηmGm, W (94)m x (84)m	488.89	507.90	475.98	397.16	303.46	201.95	135.68	141.79	220.15	338.68	433.51	473.24	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	563.97	544.61	489.33	399.71	303.76	201.96	135.69	141.79	220.19	340.79	460.42	558.11	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	55.86	24.67	9.94	1.84	0.22	0.00	0.00	0.00	0.00	1.57	19.37	63.15	

∑(98)1...5, 10...12 = 176.60 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	176.60		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	185.43	(307a)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1626.87	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	18.12	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	76.25	(330a)

Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2120.37	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	185.43	x	4.24	x 0.01 =	7.86	(340a)
Water heating from boilers	1626.87	x	4.24	x 0.01 =	68.98	(342a)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		237.47	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.35	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1860.68	x	0.216	=	401.91	(367)
Electrical energy for community heat distribution	18.12	x	0.519	=	9.41	(372)
Total CO2 associated with community systems					411.31	(373)
Total CO2 associated with space and water heating					411.31	(376)
Pumps and fans	76.25	x	0.519	=	39.57	(378)
Electricity for lighting	231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year				(376)..(382) =	571.20	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.42	(384)
EI value					91.94	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1860.68	x	1.22	=	2270.03	(367)
Electrical energy for community heat distribution	18.12	x	3.07	=	55.64	(372)
Total primary energy associated with community systems					2325.67	(373)
Total primary energy associated with space and water heating					2325.67	(376)
Pumps and fans	76.25	x	3.07	=	234.09	(378)
Electricity for lighting	231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year					3271.42	(383)

Dwelling primary energy rate kWh/m2/year	65.43	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ho 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = 0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			40.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.00 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.00 (36)
Total fabric heat loss	(33) + (36) =	24.00 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

34.85	34.72	34.59	33.93	33.80	33.14	33.14	33.01	33.40	33.80	34.06	34.32	

Average = ∑(39)1...12/12 = 33.90 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.70	0.69	0.69	0.68	0.68	0.66	0.66	0.66	0.67	0.68	0.68	0.69	

Average = ∑(40)1...12/12 = 0.68 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34	(83)

Total gains - internal and solar (73)m + (83)m

543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.91	0.84	0.73	0.60	0.46	0.33	0.23	0.24	0.37	0.60	0.82	0.93	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.82	20.91	20.97	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.94	20.80	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.34	20.35	20.35	20.36	20.36	20.37	20.37	20.38	20.37	20.36	20.36	20.35	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.90	0.81	0.71	0.57	0.43	0.29	0.20	0.21	0.34	0.56	0.80	0.91	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.13	20.24	20.31	20.35	20.36	20.37	20.37	20.38	20.37	20.36	20.29	20.11	(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.48	20.59	20.65	20.68	20.69	20.69	20.69	20.70	20.69	20.68	20.62	20.46	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.48	20.59	20.65	20.68	20.69	20.69	20.69	20.70	20.69	20.68	20.62	20.46	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.90	0.82	0.72	0.58	0.45	0.31	0.22	0.23	0.36	0.58	0.81	0.92	(94)
Useful gains, ηmGm, W (94)m x (84)m	488.89	507.90	475.98	397.16	303.46	201.95	135.68	141.79	220.15	338.68	433.51	473.24	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	563.97	544.61	489.33	399.71	303.76	201.96	135.69	141.79	220.19	340.79	460.42	558.11	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	55.86	24.67	9.94	1.84	0.22	0.00	0.00	0.00	0.00	1.57	19.37	63.15	

∑(98)1...5, 10...12 = 176.60 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	176.60		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	37.09	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	148.35	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	18.12	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2120.37	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	37.09	x	2.97	x 0.01 =	1.10	(340a)
Space heating from boilers	148.35	x	4.24	x 0.01 =	6.29	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		232.87	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.64	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	68.6233	x	0.2160	=	14.8226	(363)
less credit emissions for electricity		-22.7527	x	0.5190	=	-11.8086	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1488.55	x	0.216	=	321.53	(368)
Electrical energy for community heat distribution		18.12	x	0.519	=	9.41	(372)
Total CO2 associated with community systems						360.39	(373)
Total CO2 associated with space and water heating						360.39	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year					(376)..(382) =	520.27	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.41	(384)
EI value						92.66	
EI rating (section 14)						93	(385)

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EI band	A

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	68.62	x	1.22	=	83.72	(363)
less credit energy for electricity		-22.75	x	3.07	=	-69.85	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1488.55	x	1.22	=	1816.03	(368)
Electrical energy for community heat distribution		18.12	x	3.07	=	55.64	(372)
Total primary energy associated with community systems						2007.22	(373)
Total primary energy associated with space and water heating						2007.22	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year						2952.96	(383)
Dwelling primary energy rate kWh/m2/year						59.06	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ho 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			40.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.00 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.00 (36)
Total fabric heat loss	(33) + (36) =	24.00 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

34.85	34.72	34.59	33.93	33.80	33.14	33.14	33.01	33.40	33.80	34.06	34.32	

Average = ∑(39)1...12/12 = 33.90 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.70	0.69	0.69	0.68	0.68	0.66	0.66	0.66	0.67	0.68	0.68	0.69	

Average = ∑(40)1...12/12 = 0.68 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34	(83)

Total gains - internal and solar (73)m + (83)m

543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.91	0.84	0.73	0.60	0.46	0.33	0.23	0.24	0.37	0.60	0.82	0.93	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.82	20.91	20.97	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.94	20.80	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.34	20.35	20.35	20.36	20.36	20.37	20.37	20.38	20.37	20.36	20.36	20.35	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.90	0.81	0.71	0.57	0.43	0.29	0.20	0.21	0.34	0.56	0.80	0.91	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.13	20.24	20.31	20.35	20.36	20.37	20.37	20.38	20.37	20.36	20.29	20.11	(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.48	20.59	20.65	20.68	20.69	20.69	20.69	20.70	20.69	20.68	20.62	20.46	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.48	20.59	20.65	20.68	20.69	20.69	20.69	20.70	20.69	20.68	20.62	20.46	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.90	0.82	0.72	0.58	0.45	0.31	0.22	0.23	0.36	0.58	0.81	0.92	(94)
Useful gains, ηmGm, W (94)m x (84)m	488.89	507.90	475.98	397.16	303.46	201.95	135.68	141.79	220.15	338.68	433.51	473.24	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	563.97	544.61	489.33	399.71	303.76	201.96	135.69	141.79	220.19	340.79	460.42	558.11	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	55.86	24.67	9.94	1.84	0.22	0.00	0.00	0.00	0.00	1.57	19.37	63.15	

∑(98)1...5, 10...12 = 176.60 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	176.60		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	37.09	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	148.35	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	18.12	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	1887.19	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	37.09	x	2.97	x 0.01 =	1.10	(340a)
Space heating from boilers	148.35	x	4.24	x 0.01 =	6.29	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		232.87	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.64	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	68.6233	x	0.2160	=	14.8226	(363)
less credit emissions for electricity		-22.7527	x	0.5190	=	-11.8086	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1488.55	x	0.216	=	321.53	(368)
Electrical energy for community heat distribution		18.12	x	0.519	=	9.41	(372)
Total CO2 associated with community systems						360.39	(373)
Total CO2 associated with space and water heating						360.39	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	399.25	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.99	(384)
EI value					94.37	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	68.62	x	1.22	=	83.72	(363)
less credit energy for electricity		-22.75	x	3.07	=	-69.85	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1488.55	x	1.22	=	1816.03	(368)
Electrical energy for community heat distribution		18.12	x	3.07	=	55.64	(372)
Total primary energy associated with community systems						2007.22	(373)
Total primary energy associated with space and water heating						2007.22	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2237.11	(383)
Dwelling primary energy rate kWh/m2/year						44.74	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Hr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Roof			50.00	x	0.12	=	6.00			(30)
Total area of external elements ∑A, m²			90.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.00 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.50 (36)
Total fabric heat loss	(33) + (36) =	37.50 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

48.35	48.22	48.09	47.43	47.30	46.64	46.64	46.51	46.90	47.30	47.56	47.82	

Average = ∑(39)1...12/12 = 47.40 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.97	0.96	0.96	0.95	0.95	0.93	0.93	0.93	0.94	0.95	0.95	0.96	

Average = ∑(40)1...12/12 = 0.95 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss for each month from Table 3a, 3b or 3c

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

	153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69 (62)

Solar DHW input calculated using Appendix G or Appendix H

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (63)

Output from water heater for each month (kWh/month) (62)m + (63)m

	153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

	66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

	120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34 (83)

Total gains - internal and solar (73)m + (83)m

	543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.93	0.87	0.77	0.63	0.46	0.33	0.34	0.52	0.77	0.93	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.45	20.61	20.77	20.91	20.98	21.00	21.00	21.00	20.99	20.92	20.68	20.41

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.11	20.11	20.12	20.13	20.13	20.14	20.14	20.14	20.14	20.13	20.12	20.12

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.85	0.73	0.58	0.40	0.26	0.28	0.46	0.73	0.91	0.96

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.41	19.64	19.85	20.03	20.11	20.14	20.14	20.14	20.13	20.05	19.75	19.37

(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.94	20.13	20.32	20.48	20.55	20.58	20.58	20.58	20.57	20.50	20.22	19.90

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.94	20.13	20.32	20.48	20.55	20.58	20.58	20.58	20.57	20.50	20.22	19.90

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.95	0.92	0.85	0.75	0.60	0.43	0.29	0.31	0.49	0.75	0.91	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	517.86	566.26	566.34	510.62	409.14	277.78	185.53	194.32	301.26	435.68	488.27	496.39	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	756.32	734.58	664.64	549.22	418.68	278.80	185.62	194.45	303.57	468.06	624.20	750.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	177.41	113.11	73.13	27.79	7.10	0.00	0.00	0.00	0.00	24.09	97.87	189.37	

∑(98)1...5, 10...12 = 709.87 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.20 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	709.87		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	745.36	(307a)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1626.87	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.72	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2680.29	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	745.36	x	4.24	x 0.01 =	31.60	(340a)
Water heating from boilers	1626.87	x	4.24	x 0.01 =	68.98	(342a)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		261.22	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.15	(357)
SAP value	83.89	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2435.56	x	0.216	=	526.08	(367)
Electrical energy for community heat distribution	23.72	x	0.519	=	12.31	(372)
Total CO2 associated with community systems					538.39	(373)
Total CO2 associated with space and water heating					538.39	(376)
Pumps and fans	76.25	x	0.519	=	39.57	(378)
Electricity for lighting	231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year				(376)..(382) =	698.28	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.97	(384)
EI value					90.15	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2435.56	x	1.22	=	2971.38	(367)
Electrical energy for community heat distribution	23.72	x	3.07	=	72.83	(372)
Total primary energy associated with community systems					3044.21	(373)
Total primary energy associated with space and water heating					3044.21	(376)
Pumps and fans	76.25	x	3.07	=	234.09	(378)
Electricity for lighting	231.81	x	3.07	=	711.66	(379)

Primary energy kWh/year	3989.95	(383)
Dwelling primary energy rate kWh/m2/year	79.80	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Hr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Roof			50.00	x	0.12	=	6.00			(30)
Total area of external elements ∑A, m²			90.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.00 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.50 (36)
Total fabric heat loss	(33) + (36) =	37.50 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)

Heat transfer coefficient, W/K (37)m + (38)m

48.35	48.22	48.09	47.43	47.30	46.64	46.64	46.51	46.90	47.30	47.56	47.82	

Average = ∑(39)1...12/12 = 47.40 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.97	0.96	0.96	0.95	0.95	0.93	0.93	0.93	0.94	0.95	0.95	0.96	

Average = ∑(40)1...12/12 = 0.95 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69	

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34	(83)

Total gains - internal and solar (73)m + (83)m

543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.93	0.87	0.77	0.63	0.46	0.33	0.34	0.52	0.77	0.93	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.45	20.61	20.77	20.91	20.98	21.00	21.00	21.00	20.99	20.92	20.68	20.41

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.11	20.11	20.12	20.13	20.13	20.14	20.14	20.14	20.14	20.13	20.12	20.12

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.85	0.73	0.58	0.40	0.26	0.28	0.46	0.73	0.91	0.96

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.41	19.64	19.85	20.03	20.11	20.14	20.14	20.14	20.13	20.05	19.75	19.37

(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.94	20.13	20.32	20.48	20.55	20.58	20.58	20.58	20.57	20.50	20.22	19.90

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.94	20.13	20.32	20.48	20.55	20.58	20.58	20.58	20.57	20.50	20.22	19.90

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.92	0.85	0.75	0.60	0.43	0.29	0.31	0.49	0.75	0.91	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	517.86	566.26	566.34	510.62	409.14	277.78	185.53	194.32	301.26	435.68	488.27	496.39	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	756.32	734.58	664.64	549.22	418.68	278.80	185.62	194.45	303.57	468.06	624.20	750.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	177.41	113.11	73.13	27.79	7.10	0.00	0.00	0.00	0.00	24.09	97.87	189.37	

∑(98)1...5, 10...12 = 709.87 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.20 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	709.87		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	149.07	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	596.29	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.72	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	76.25	(330a)
Total electricity for the above, kWh/year	76.25	(331)
Electricity for lighting (Appendix L)	231.81	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2680.29	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	149.07	x	2.97	x 0.01 =	4.43	(340a)
Space heating from boilers	596.29	x	4.24	x 0.01 =	25.28	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		255.19	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.26	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	275.8340	x	0.2160	=	59.5801	(363)
less credit emissions for electricity		-91.4552	x	0.5190	=	-47.4653	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1948.45	x	0.216	=	420.86	(368)
Electrical energy for community heat distribution		23.72	x	0.519	=	12.31	(372)
Total CO2 associated with community systems						471.73	(373)
Total CO2 associated with space and water heating						471.73	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)
Electricity for lighting		231.81	x	0.519	=	120.31	(379)
Total CO_2, kg/year					(376)..(382) =	631.62	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.63	(384)
EI value						91.09	

EI rating (section 14)	91	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	275.83	x	1.22	=	336.52	(363)
less credit energy for electricity		-91.46	x	3.07	=	-280.77	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1948.45	x	1.22	=	2377.10	(368)
Electrical energy for community heat distribution		23.72	x	3.07	=	72.83	(372)
Total primary energy associated with community systems						2627.36	(373)
Total primary energy associated with space and water heating						2627.36	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Primary energy kWh/year						3573.11	(383)
Dwelling primary energy rate kWh/m2/year						71.46	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Hr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			9.57	x	1.24	=	11.83			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			28.54	x	0.15	=	4.28			(29a)
Party wall			30.00	x	0.00	=	0.00			(32)
Roof			50.00	x	0.12	=	6.00			(30)
Total area of external elements ∑A, m²			90.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.00 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.50 (36)
Total fabric heat loss	(33) + (36) =	37.50 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	10.85	10.72	10.59	9.93	9.80	9.14	9.14	9.01	9.41	9.80	10.06	10.33	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	48.35	48.22	48.09	47.43	47.30	46.64	46.64	46.51	46.90	47.30	47.56	47.82	
										Average = ∑(39)1...12/12 =		47.40	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	0.97	0.96	0.96	0.95	0.95	0.93	0.93	0.93	0.94	0.95	0.95	0.96	
										Average = ∑(40)1...12/12 =		0.95	(40)
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	
											∑(44)1...12 =	892.08	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	
											∑(45)1...12 =	1169.66	(45)
Distribution loss 0.15 x (45)m													
	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m													
	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)													
	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

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Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss for each month from Table 3a, 3b or 3c

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

	153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69 (62)

Solar DHW input calculated using Appendix G or Appendix H

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (63)

Output from water heater for each month (kWh/month) (62)m + (63)m

	153.52	135.19	141.70	126.63	123.81	110.22	105.46	116.26	116.23	131.33	139.36	149.69

∑(64)1...12 = 1549.40 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

	66.12	58.57	62.19	56.70	56.24	51.24	50.14	53.74	53.24	58.74	60.93	64.85 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.82	29.15	23.70	17.94	13.41	11.32	12.24	15.91	21.35	27.11	31.64	33.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	88.88	87.16	83.59	78.74	75.60	71.17	67.40	72.22	73.94	78.96	84.62	87.17	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	422.08	418.97	404.21	381.37	358.25	337.22	324.67	330.88	343.79	366.80	392.44	411.58	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
South	0.77	x	7.92	x	46.75	x 0.9 x	0.50	x	0.90	=	115.47	(78)

Solar gains in watts ∑(74)m...(82)m

	120.94	199.57	258.66	300.80	322.16	314.19	305.20	289.56	273.00	216.42	143.62	104.34 (83)

Total gains - internal and solar (73)m + (83)m

	543.02	618.54	662.88	682.18	680.41	651.41	629.87	620.44	616.79	583.22	536.06	515.92 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.93	0.87	0.77	0.63	0.46	0.33	0.34	0.52	0.77	0.93	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.45	20.61	20.77	20.91	20.98	21.00	21.00	21.00	20.99	20.92	20.68	20.41

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.11	20.11	20.12	20.13	20.13	20.14	20.14	20.14	20.14	20.13	20.12	20.12

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.85	0.73	0.58	0.40	0.26	0.28	0.46	0.73	0.91	0.96

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.41	19.64	19.85	20.03	20.11	20.14	20.14	20.14	20.13	20.05	19.75	19.37

(90)

Living area fraction — Living area ÷ (4) = 0.51 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.94	20.13	20.32	20.48	20.55	20.58	20.58	20.58	20.57	20.50	20.22	19.90

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.94	20.13	20.32	20.48	20.55	20.58	20.58	20.58	20.57	20.50	20.22	19.90

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.92	0.85	0.75	0.60	0.43	0.29	0.31	0.49	0.75	0.91	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	517.86	566.26	566.34	510.62	409.14	277.78	185.53	194.32	301.26	435.68	488.27	496.39	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	756.32	734.58	664.64	549.22	418.68	278.80	185.62	194.45	303.57	468.06	624.20	750.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	177.41	113.11	73.13	27.79	7.10	0.00	0.00	0.00	0.00	24.09	97.87	189.37	

∑(98)1...5, 10...12 = 709.87 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.20 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	709.87		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	149.07	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	596.29	(307b)

Water heating

Annual water heating requirement	1549.40		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.37	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1301.50	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.72	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.25		(330a)
Total electricity for the above, kWh/year		76.25	(331)
Electricity for lighting (Appendix L)		231.81	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2447.11	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	149.07	x	2.97	x 0.01 =	4.43	(340a)
Space heating from boilers	596.29	x	4.24	x 0.01 =	25.28	(340b)
Water heating from CHP	325.37	x	2.97	x 0.01 =	9.66	(342a)
Water heating from boilers	1301.50	x	4.24	x 0.01 =	55.18	(342b)
Pumps and fans	76.25	x	13.19	x 0.01 =	10.06	(349)
Electricity for lighting	231.81	x	13.19	x 0.01 =	30.58	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		255.19	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.26	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	275.8340	x	0.2160	=	59.5801	(363)
less credit emissions for electricity		-91.4552	x	0.5190	=	-47.4653	(364)
Water heated by CHP		602.0535	x	0.2160	=	130.0436	(365)
less credit emissions for electricity		-199.6162	x	0.5190	=	-103.6008	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1948.45	x	0.216	=	420.86	(368)
Electrical energy for community heat distribution		23.72	x	0.519	=	12.31	(372)
Total CO2 associated with community systems						471.73	(373)
Total CO2 associated with space and water heating						471.73	(376)
Pumps and fans		76.25	x	0.519	=	39.57	(378)

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Electricity for lighting	231.81	x	0.519	=	120.31	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	510.60	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.21	(384)
EI value					92.80	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	275.83	x	1.22	=	336.52	(363)
less credit energy for electricity		-91.46	x	3.07	=	-280.77	(364)
Water heated by CHP		602.05	x	1.22	=	734.51	(365)
less credit energy for electricity		-199.62	x	3.07	=	-612.82	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1948.45	x	1.22	=	2377.10	(368)
Electrical energy for community heat distribution		23.72	x	3.07	=	72.83	(372)
Total primary energy associated with community systems						2627.36	(373)
Total primary energy associated with space and water heating						2627.36	(376)
Pumps and fans		76.25	x	3.07	=	234.09	(378)
Electricity for lighting		231.81	x	3.07	=	711.66	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2857.25	(383)
Dwelling primary energy rate kWh/m2/year						57.15	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	If 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			1.89	x	1.00	=	1.89			(26)
Exposed floor			22.00	x	0.20	=	4.40			(28b
Exposed floor			73.00	x	0.19	=	13.80			(28b
External wall			45.47	x	0.15	=	6.82			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			161.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	50.25 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		24.19 (36)
Total fabric heat loss	(33) + (36) =	74.44 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

95.06	94.81	94.56	93.31	93.06	91.81	91.81	91.56	92.31	93.06	93.56	94.06	

Average = ∑(39)1...12/12 = 93.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	1.00	0.98	0.98	0.97	0.97	0.96	0.97	0.98	0.98	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	

∑(64)1...12 = 1922.36 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

78.98	69.82	73.80	66.81	65.95	59.62	57.91	62.64	62.25	69.25	72.39	77.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	106.16	103.89	99.19	92.80	88.64	82.80	77.83	84.20	86.46	93.08	100.55	103.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	639.13	634.53	610.98	574.28	536.49	502.68	482.92	491.62	512.73	549.65	590.76	622.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37	(83)

Total gains - internal and solar (73)m + (83)m

856.39	1000.96	1103.11	1169.27	1189.92	1145.80	1105.27	1071.14	1040.56	952.11	850.31	808.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	0.99	0.97	0.93	0.84	0.69	0.51	0.36	0.39	0.60	0.86	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.24	20.43	20.64	20.85	20.96	20.99	21.00	21.00	20.98	20.85	20.51	20.21	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.08	20.09	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.10	20.09	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	0.98	0.96	0.91	0.80	0.64	0.44	0.29	0.32	0.53	0.82	0.96	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.10	19.37	19.66	19.93	20.06	20.11	20.11	20.11	20.10	19.94	19.50	19.05	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
	19.48	19.72	19.99	20.24	20.36	20.40	20.41	20.41	20.39	20.24	19.83	19.43	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.48	19.72	19.99	20.24	20.36	20.40	20.41	20.41	20.39	20.24	19.83	19.43	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.98	0.95	0.90	0.81	0.65	0.46	0.32	0.34	0.55	0.82	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	837.30	953.42	997.11	941.56	775.64	529.23	349.08	366.38	571.64	785.46	810.56	794.46	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	1442.93	1405.04	1275.35	1057.71	805.73	532.62	349.39	366.86	580.71	897.31	1191.25	1432.82	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	450.59	303.49	207.01	83.63	22.38	0.00	0.00	0.00	0.00	83.22	274.10	474.94	

∑(98)1...5, 10...12 = 1899.36 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.99 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1899.36		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1994.33	(307a)

Water heating

Annual water heating requirement	1922.36		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	2018.48	(310a)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.13	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4595.20	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1994.33	x	4.24	x 0.01 =	84.56	(340a)
Water heating from boilers	2018.48	x	4.24	x 0.01 =	85.58	(342a)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		366.96	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.64	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	4119.93	x	0.216	=	889.90	(367)
Electrical energy for community heat distribution	40.13	x	0.519	=	20.83	(372)
Total CO2 associated with community systems					910.73	(373)
Total CO2 associated with space and water heating					910.73	(376)
Pumps and fans	191.96	x	0.519	=	99.63	(378)
Electricity for lighting	390.43	x	0.519	=	202.63	(379)
Total CO_2, kg/year				(376)..(382) =	1212.99	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.77	(384)
EI value					88.39	
EI rating (section 14)					88	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	4119.93	x	1.22	=	5026.31	(367)
Electrical energy for community heat distribution	40.13	x	3.07	=	123.19	(372)
Total primary energy associated with community systems					5149.51	(373)

Total primary energy associated with space and water heating					5149.51	(376)
Pumps and fans	191.96	x	3.07	=	589.32	(378)
Electricity for lighting	390.43	x	3.07	=	1198.62	(379)
Primary energy kWh/year					6937.44	(383)
Dwelling primary energy rate kWh/m2/year					73.03	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	If 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			1.89	x	1.00	=	1.89			(26)
Exposed floor			22.00	x	0.20	=	4.40			(28b
Exposed floor			73.00	x	0.19	=	13.80			(28b
External wall			45.47	x	0.15	=	6.82			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			161.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	50.25 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		24.19 (36)
Total fabric heat loss	(33) + (36) =	74.44 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

95.06	94.81	94.56	93.31	93.06	91.81	91.81	91.56	92.31	93.06	93.56	94.06	

Average = ∑(39)1...12/12 = 93.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	1.00	0.98	0.98	0.97	0.97	0.96	0.97	0.98	0.98	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	

∑(64)1...12 = 1922.36 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

78.98	69.82	73.80	66.81	65.95	59.62	57.91	62.64	62.25	69.25	72.39	77.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	106.16	103.89	99.19	92.80	88.64	82.80	77.83	84.20	86.46	93.08	100.55	103.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	639.13	634.53	610.98	574.28	536.49	502.68	482.92	491.62	512.73	549.65	590.76	622.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37	(83)

Total gains - internal and solar (73)m + (83)m

856.39	1000.96	1103.11	1169.27	1189.92	1145.80	1105.27	1071.14	1040.56	952.11	850.31	808.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	0.99	0.97	0.93	0.84	0.69	0.51	0.36	0.39	0.60	0.86	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.24	20.43	20.64	20.85	20.96	20.99	21.00	21.00	20.98	20.85	20.51	20.21	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.08	20.09	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.10	20.09	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	0.98	0.96	0.91	0.80	0.64	0.44	0.29	0.32	0.53	0.82	0.96	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.10	19.37	19.66	19.93	20.06	20.11	20.11	20.11	20.10	19.94	19.50	19.05	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
	19.48	19.72	19.99	20.24	20.36	20.40	20.41	20.41	20.39	20.24	19.83	19.43	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.48	19.72	19.99	20.24	20.36	20.40	20.41	20.41	20.39	20.24	19.83	19.43	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.98	0.95	0.90	0.81	0.65	0.46	0.32	0.34	0.55	0.82	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	837.30	953.42	997.11	941.56	775.64	529.23	349.08	366.38	571.64	785.46	810.56	794.46	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	1442.93	1405.04	1275.35	1057.71	805.73	532.62	349.39	366.86	580.71	897.31	1191.25	1432.82	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	450.59	303.49	207.01	83.63	22.38	0.00	0.00	0.00	0.00	83.22	274.10	474.94	

∑(98)1...5, 10...12 = 1899.36 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.99 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1899.36		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	398.87	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1595.47	(307b)

Water heating

Annual water heating requirement	1922.36		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	403.70	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1614.78	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.13	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4595.20	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	398.87	x	2.97	x 0.01 =	11.85	(340a)
Space heating from boilers	1595.47	x	4.24	x 0.01 =	67.65	(340b)
Water heating from CHP	403.70	x	2.97	x 0.01 =	11.99	(342a)
Water heating from boilers	1614.78	x	4.24	x 0.01 =	68.47	(342b)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		356.77	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.07	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	738.0390	x	0.2160	=	159.4164	(363)
less credit emissions for electricity		-244.7034	x	0.5190	=	-127.0011	(364)
Water heated by CHP		746.9744	x	0.2160	=	161.3465	(365)
less credit emissions for electricity		-247.6660	x	0.5190	=	-128.5387	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3295.94	x	0.216	=	711.92	(368)
Electrical energy for community heat distribution		40.13	x	0.519	=	20.83	(372)
Total CO2 associated with community systems						797.97	(373)
Total CO2 associated with space and water heating						797.97	(376)
Pumps and fans		191.96	x	0.519	=	99.63	(378)
Electricity for lighting		390.43	x	0.519	=	202.63	(379)

Total CO_2, kg/year	(376)..(382) =	1100.23	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	11.58	(384)
EI value		89.47	
EI rating (section 14)		89	(385)
EI band		B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	738.04	x	1.22	=	900.41	(363)
less credit energy for electricity		-244.70	x	3.07	=	-751.24	(364)
Water heated by CHP		746.97	x	1.22	=	911.31	(365)
less credit energy for electricity		-247.67	x	3.07	=	-760.33	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3295.94	x	1.22	=	4021.05	(368)
Electrical energy for community heat distribution		40.13	x	3.07	=	123.19	(372)
Total primary energy associated with community systems						4444.39	(373)
Total primary energy associated with space and water heating						4444.39	(376)
Pumps and fans		191.96	x	3.07	=	589.32	(378)
Electricity for lighting		390.43	x	3.07	=	1198.62	(379)
Primary energy kWh/year						6232.32	(383)
Dwelling primary energy rate kWh/m2/year						65.60	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	If 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			1.89	x	1.00	=	1.89			(26)
Exposed floor			22.00	x	0.20	=	4.40			(28b
Exposed floor			73.00	x	0.19	=	13.80			(28b
External wall			45.47	x	0.15	=	6.82			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			161.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	50.25 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		24.19 (36)
Total fabric heat loss	(33) + (36) =	74.44 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

95.06	94.81	94.56	93.31	93.06	91.81	91.81	91.56	92.31	93.06	93.56	94.06	

Average = ∑(39)1...12/12 = 93.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	1.00	0.98	0.98	0.97	0.97	0.96	0.97	0.98	0.98	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	

∑(64)1...12 = 1922.36 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

78.98	69.82	73.80	66.81	65.95	59.62	57.91	62.64	62.25	69.25	72.39	77.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	106.16	103.89	99.19	92.80	88.64	82.80	77.83	84.20	86.46	93.08	100.55	103.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	639.13	634.53	610.98	574.28	536.49	502.68	482.92	491.62	512.73	549.65	590.76	622.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37	(83)

Total gains - internal and solar (73)m + (83)m

856.39	1000.96	1103.11	1169.27	1189.92	1145.80	1105.27	1071.14	1040.56	952.11	850.31	808.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)													
	0.99	0.97	0.93	0.84	0.69	0.51	0.36	0.39	0.60	0.86	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.24	20.43	20.64	20.85	20.96	20.99	21.00	21.00	20.98	20.85	20.51	20.21	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.08	20.09	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.10	20.09	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	0.98	0.96	0.91	0.80	0.64	0.44	0.29	0.32	0.53	0.82	0.96	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.10	19.37	19.66	19.93	20.06	20.11	20.11	20.11	20.10	19.94	19.50	19.05	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
	19.48	19.72	19.99	20.24	20.36	20.40	20.41	20.41	20.39	20.24	19.83	19.43	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.48	19.72	19.99	20.24	20.36	20.40	20.41	20.41	20.39	20.24	19.83	19.43	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.98	0.95	0.90	0.81	0.65	0.46	0.32	0.34	0.55	0.82	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	837.30	953.42	997.11	941.56	775.64	529.23	349.08	366.38	571.64	785.46	810.56	794.46	(95)
Monthly average external temperature from Table U1													
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	1442.93	1405.04	1275.35	1057.71	805.73	532.62	349.39	366.86	580.71	897.31	1191.25	1432.82	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	450.59	303.49	207.01	83.63	22.38	0.00	0.00	0.00	0.00	83.22	274.10	474.94	

∑(98)1...5, 10...12 = 1899.36 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.99 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1899.36		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	398.87	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1595.47	(307b)

Water heating

Annual water heating requirement	1922.36		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	403.70	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1614.78	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.13	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4362.02	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	398.87	x	2.97	x 0.01 =	11.85	(340a)
Space heating from boilers	1595.47	x	4.24	x 0.01 =	67.65	(340b)
Water heating from CHP	403.70	x	2.97	x 0.01 =	11.99	(342a)
Water heating from boilers	1614.78	x	4.24	x 0.01 =	68.47	(342b)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		356.77	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.07	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)						
Power efficiency of CHP unit	33.16					(361)
Heat efficiency of CHP unit	54.04					(362)
Space heating from CHP (307a) × 100 ÷ (362) =	738.0390	x	0.2160	=	159.4164	(363)
less credit emissions for electricity	-244.7034	x	0.5190	=	-127.0011	(364)
Water heated by CHP	746.9744	x	0.2160	=	161.3465	(365)
less credit emissions for electricity	-247.6660	x	0.5190	=	-128.5387	(366)
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367b)
CO2 emissions from boilers [(307b)+(310b)] x 100 ÷ (367b) =	3295.94	x	0.216	=	711.92	(368)
Electrical energy for community heat distribution	40.13	x	0.519	=	20.83	(372)

Total CO2 associated with community systems					797.97	(373)
Total CO2 associated with space and water heating					797.97	(376)
Pumps and fans	191.96	x	0.519	=	99.63	(378)
Electricity for lighting	390.43	x	0.519	=	202.63	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	979.21	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.31	(384)
EI value					90.63	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	738.04	x	1.22	=	900.41	(363)
less credit energy for electricity		-244.70	x	3.07	=	-751.24	(364)
Water heated by CHP		746.97	x	1.22	=	911.31	(365)
less credit energy for electricity		-247.67	x	3.07	=	-760.33	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3295.94	x	1.22	=	4021.05	(368)
Electrical energy for community heat distribution		40.13	x	3.07	=	123.19	(372)
Total primary energy associated with community systems						4444.39	(373)
Total primary energy associated with space and water heating						4444.39	(376)
Pumps and fans		191.96	x	3.07	=	589.32	(378)
Electricity for lighting		390.43	x	3.07	=	1198.62	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						5516.47	(383)
Dwelling primary energy rate kWh/m2/year						58.07	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Io 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			18.90	x	1.00	=	18.90			(26)
External wall			28.46	x	0.15	=	4.27			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			66.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	46.51 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.94 (36)
Total fabric heat loss	(33) + (36) =	56.45 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

77.07	76.82	76.57	75.32	75.07	73.82	73.82	73.57	74.32	75.07	75.57	76.07	

Average = ∑(39)1...12/12 = 75.26 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.81	0.81	0.81	0.79	0.79	0.78	0.78	0.77	0.78	0.79	0.80	0.80	

Average = ∑(40)1...12/12 = 0.79 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	

∑(64)1...12 = 1922.36 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

78.98	69.82	73.80	66.81	65.95	59.62	57.91	62.64	62.25	69.25	72.39	77.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	106.16	103.89	99.19	92.80	88.64	82.80	77.83	84.20	86.46	93.08	100.55	103.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	639.13	634.53	610.98	574.28	536.49	502.68	482.92	491.62	512.73	549.65	590.76	622.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37	(83)

Total gains - internal and solar (73)m + (83)m

856.39	1000.96	1103.11	1169.27	1189.92	1145.80	1105.27	1071.14	1040.56	952.11	850.31	808.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.94	0.87	0.74	0.58	0.41	0.29	0.32	0.49	0.77	0.94	0.98

(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.53	20.69	20.85	20.95	20.99	21.00	21.00	21.00	21.00	20.95	20.74	20.49

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.24	20.25	20.25	20.26	20.26	20.27	20.27	20.28	20.27	20.26	20.26	20.25

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.85	0.71	0.54	0.37	0.25	0.27	0.44	0.73	0.93	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.63	19.86	20.07	20.21	20.26	20.27	20.27	20.28	20.27	20.21	19.94	19.59

(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.93	20.14	20.33	20.46	20.50	20.51	20.51	20.52	20.51	20.46	20.21	19.89

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.93	20.14	20.33	20.46	20.50	20.51	20.51	20.52	20.51	20.46	20.21	19.89

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.93	0.85	0.72	0.55	0.38	0.26	0.28	0.46	0.74	0.93	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	829.30	928.80	940.17	837.80	655.32	436.22	288.93	302.76	475.19	706.14	789.28	788.90	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1204.39	1170.52	1058.70	870.64	660.56	436.55	288.95	302.79	476.35	740.12	990.38	1193.27	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	279.07	162.43	88.18	23.64	3.90	0.00	0.00	0.00	0.00	25.28	144.79	300.85	

∑(98)1...5, 10...12 = 1028.14 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1028.14		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1079.55	(307a)

Water heating

Annual water heating requirement	1922.36		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	2018.48	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	30.98	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3680.42	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1079.55	x	4.24	x 0.01 =	45.77	(340a)
Water heating from boilers	2018.48	x	4.24	x 0.01 =	85.58	(342a)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		328.17	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.98	(357)
SAP value	86.27	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3180.73	x	0.216	=	687.04	(367)
Electrical energy for community heat distribution	30.98	x	0.519	=	16.08	(372)
Total CO2 associated with community systems					703.12	(373)
Total CO2 associated with space and water heating					703.12	(376)
Pumps and fans	191.96	x	0.519	=	99.63	(378)
Electricity for lighting	390.43	x	0.519	=	202.63	(379)
Total CO_2, kg/year				(376)..(382) =	1005.38	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.58	(384)
EI value					90.38	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3180.73	x	1.22	=	3880.49	(367)
Electrical energy for community heat distribution	30.98	x	3.07	=	95.11	(372)
Total primary energy associated with community systems					3975.60	(373)
Total primary energy associated with space and water heating					3975.60	(376)
Pumps and fans	191.96	x	3.07	=	589.32	(378)

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Electricity for lighting	390.43	x	3.07	=	1198.62	(379)
Primary energy kWh/year					5763.53	(383)
Dwelling primary energy rate kWh/m2/year					60.67	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Io 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			18.90	x	1.00	=	18.90			(26)
External wall			28.46	x	0.15	=	4.27			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			66.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	46.51 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.94 (36)
Total fabric heat loss	(33) + (36) =	56.45 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

77.07	76.82	76.57	75.32	75.07	73.82	73.82	73.57	74.32	75.07	75.57	76.07	

Average = ∑(39)1...12/12 = 75.26 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.81	0.81	0.81	0.79	0.79	0.78	0.78	0.77	0.78	0.79	0.80	0.80	

Average = ∑(40)1...12/12 = 0.79 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	

∑(64)1...12 = 1922.36 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

78.98	69.82	73.80	66.81	65.95	59.62	57.91	62.64	62.25	69.25	72.39	77.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	106.16	103.89	99.19	92.80	88.64	82.80	77.83	84.20	86.46	93.08	100.55	103.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	639.13	634.53	610.98	574.28	536.49	502.68	482.92	491.62	512.73	549.65	590.76	622.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37	(83)

Total gains - internal and solar (73)m + (83)m

856.39	1000.96	1103.11	1169.27	1189.92	1145.80	1105.27	1071.14	1040.56	952.11	850.31	808.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.94	0.87	0.74	0.58	0.41	0.29	0.32	0.49	0.77	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.53	20.69	20.85	20.95	20.99	21.00	21.00	21.00	21.00	20.95	20.74	20.49	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.24	20.25	20.25	20.26	20.26	20.27	20.27	20.28	20.27	20.26	20.26	20.25	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.85	0.71	0.54	0.37	0.25	0.27	0.44	0.73	0.93	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.63	19.86	20.07	20.21	20.26	20.27	20.27	20.28	20.27	20.21	19.94	19.59	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.93	20.14	20.33	20.46	20.50	20.51	20.51	20.52	20.51	20.46	20.21	19.89	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.93	20.14	20.33	20.46	20.50	20.51	20.51	20.52	20.51	20.46	20.21	19.89	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.93	0.85	0.72	0.55	0.38	0.26	0.28	0.46	0.74	0.93	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	829.30	928.80	940.17	837.80	655.32	436.22	288.93	302.76	475.19	706.14	789.28	788.90	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1204.39	1170.52	1058.70	870.64	660.56	436.55	288.95	302.79	476.35	740.12	990.38	1193.27	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	279.07	162.43	88.18	23.64	3.90	0.00	0.00	0.00	0.00	25.28	144.79	300.85	

∑(98)1...5, 10...12 = 1028.14 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1028.14		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	215.91	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	863.64	(307b)

Water heating

Annual water heating requirement	1922.36		(64)

Water heat from CHP	(64) x (303a) x (305a) x (306) =	403.70	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1614.78	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	30.98	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3680.42	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	215.91	x	2.97	x 0.01 =	6.41	(340a)
Space heating from boilers	863.64	x	4.24	x 0.01 =	36.62	(340b)
Water heating from CHP	403.70	x	2.97	x 0.01 =	11.99	(342a)
Water heating from boilers	1614.78	x	4.24	x 0.01 =	68.47	(342b)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		320.30	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.60	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	399.5067	x	0.2160	=	86.2935	(363)
less credit emissions for electricity		-132.4600	x	0.5190	=	-68.7468	(364)
Water heated by CHP		746.9744	x	0.2160	=	161.3465	(365)
less credit emissions for electricity		-247.6660	x	0.5190	=	-128.5387	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2544.58	x	0.216	=	549.63	(368)
Electrical energy for community heat distribution		30.98	x	0.519	=	16.08	(372)
Total CO2 associated with community systems						616.06	(373)
Total CO2 associated with space and water heating						616.06	(376)
Pumps and fans		191.96	x	0.519	=	99.63	(378)
Electricity for lighting		390.43	x	0.519	=	202.63	(379)
Total CO_2, kg/year					(376)..(382) =	918.32	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.67	(384)

EI value	91.21	
EI rating (section 14)	91	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	399.51	x	1.22	=	487.40	(363)
less credit energy for electricity		-132.46	x	3.07	=	-406.65	(364)
Water heated by CHP		746.97	x	1.22	=	911.31	(365)
less credit energy for electricity		-247.67	x	3.07	=	-760.33	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2544.58	x	1.22	=	3104.39	(368)
Electrical energy for community heat distribution		30.98	x	3.07	=	95.11	(372)
Total primary energy associated with community systems						3431.22	(373)
Total primary energy associated with space and water heating						3431.22	(376)
Pumps and fans		191.96	x	3.07	=	589.32	(378)
Electricity for lighting		390.43	x	3.07	=	1198.62	(379)
Primary energy kWh/year						5219.15	(383)
Dwelling primary energy rate kWh/m2/year						54.94	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Io 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			18.90	x	1.00	=	18.90			(26)
External wall			28.46	x	0.15	=	4.27			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			66.25							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	46.51 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.94 (36)
Total fabric heat loss	(33) + (36) =	56.45 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

77.07	76.82	76.57	75.32	75.07	73.82	73.82	73.57	74.32	75.07	75.57	76.07	

Average = ∑(39)1...12/12 = 75.26 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.81	0.81	0.81	0.79	0.79	0.78	0.78	0.77	0.78	0.79	0.80	0.80	

Average = ∑(40)1...12/12 = 0.79 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14	

∑(64)1...12 = 1922.36 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

78.98	69.82	73.80	66.81	65.95	59.62	57.91	62.64	62.25	69.25	72.39	77.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	106.16	103.89	99.19	92.80	88.64	82.80	77.83	84.20	86.46	93.08	100.55	103.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	639.13	634.53	610.98	574.28	536.49	502.68	482.92	491.62	512.73	549.65	590.76	622.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37	(83)

Total gains - internal and solar (73)m + (83)m

856.39	1000.96	1103.11	1169.27	1189.92	1145.80	1105.27	1071.14	1040.56	952.11	850.31	808.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.94	0.87	0.74	0.58	0.41	0.29	0.32	0.49	0.77	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.53	20.69	20.85	20.95	20.99	21.00	21.00	21.00	21.00	20.95	20.74	20.49	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.24	20.25	20.25	20.26	20.26	20.27	20.27	20.28	20.27	20.26	20.26	20.25	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.85	0.71	0.54	0.37	0.25	0.27	0.44	0.73	0.93	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.63	19.86	20.07	20.21	20.26	20.27	20.27	20.28	20.27	20.21	19.94	19.59	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.93	20.14	20.33	20.46	20.50	20.51	20.51	20.52	20.51	20.46	20.21	19.89	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.93	20.14	20.33	20.46	20.50	20.51	20.51	20.52	20.51	20.46	20.21	19.89	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.93	0.85	0.72	0.55	0.38	0.26	0.28	0.46	0.74	0.93	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	829.30	928.80	940.17	837.80	655.32	436.22	288.93	302.76	475.19	706.14	789.28	788.90	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1204.39	1170.52	1058.70	870.64	660.56	436.55	288.95	302.79	476.35	740.12	990.38	1193.27	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	279.07	162.43	88.18	23.64	3.90	0.00	0.00	0.00	0.00	25.28	144.79	300.85	

∑(98)1...5, 10...12 = 1028.14 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1028.14		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	215.91	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	863.64	(307b)

Water heating

Annual water heating requirement	1922.36		(64)

Water heat from CHP	(64) x (303a) x (305a) x (306) =	403.70	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1614.78	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	30.98	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3447.24	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	215.91	x	2.97	x 0.01 =	6.41	(340a)
Space heating from boilers	863.64	x	4.24	x 0.01 =	36.62	(340b)
Water heating from CHP	403.70	x	2.97	x 0.01 =	11.99	(342a)
Water heating from boilers	1614.78	x	4.24	x 0.01 =	68.47	(342b)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		320.30	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.60	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	399.5067	x	0.2160	=	86.2935	(363)
less credit emissions for electricity		-132.4600	x	0.5190	=	-68.7468	(364)
Water heated by CHP		746.9744	x	0.2160	=	161.3465	(365)
less credit emissions for electricity		-247.6660	x	0.5190	=	-128.5387	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2544.58	x	0.216	=	549.63	(368)
Electrical energy for community heat distribution		30.98	x	0.519	=	16.08	(372)
Total CO2 associated with community systems						616.06	(373)
Total CO2 associated with space and water heating						616.06	(376)

Pumps and fans	191.96	x	0.519	=	99.63	(378)
Electricity for lighting	390.43	x	0.519	=	202.63	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	797.30	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	8.39	(384)
EI value					92.37	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	399.51	x	1.22	=	487.40	(363)
less credit energy for electricity		-132.46	x	3.07	=	-406.65	(364)
Water heated by CHP		746.97	x	1.22	=	911.31	(365)
less credit energy for electricity		-247.67	x	3.07	=	-760.33	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2544.58	x	1.22	=	3104.39	(368)
Electrical energy for community heat distribution		30.98	x	3.07	=	95.11	(372)
Total primary energy associated with community systems						3431.22	(373)
Total primary energy associated with space and water heating						3431.22	(376)
Pumps and fans		191.96	x	3.07	=	589.32	(378)
Electricity for lighting		390.43	x	3.07	=	1198.62	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						4503.30	(383)
Dwelling primary energy rate kWh/m2/year						47.40	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ir 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			45.47	x	0.15	=	6.82			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Roof			67.20	x	0.12	=	8.06			(30)
Total area of external elements ∑A, m²			133.45							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.12 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.02 (36)
Total fabric heat loss	(33) + (36) =	60.14 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

80.75	80.50	80.25	79.00	78.75	77.51	77.51	77.26	78.00	78.75	79.25	79.75	

Average = ∑(39)1...12/12 = 78.94 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.85	0.84	0.83	0.83	0.82	0.82	0.81	0.82	0.83	0.83	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.23 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.23 (50)
Enter (50) or (54) in (55)	0.23 (55)

Water storage loss calculated for each month (55) x (41)m

7.13	6.44	7.13	6.90	7.13	6.90	7.13	7.13	6.90	7.13	6.90	7.13	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

7.13	6.44	7.13	6.90	7.13	6.90	7.13	7.13	6.90	7.13	6.90	7.13	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

190.33	167.33	174.74	155.26	151.14	133.61	126.95	141.19	141.53	161.06	172.04	185.28	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

190.33	167.33	174.74	155.26	151.14	133.61	126.95	141.19	141.53	161.06	172.04	185.28	

∑(64)1...12 = 1900.46 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

77.49	68.47	72.31	65.37	64.46	58.18	56.42	61.15	60.81	67.76	70.95	75.81	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	104.16	101.89	97.19	90.80	86.64	80.80	75.83	82.20	84.46	91.08	98.55	101.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	637.13	632.53	608.98	572.28	534.49	500.68	480.92	489.62	510.73	547.65	588.76	620.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37	(83)

Total gains - internal and solar (73)m + (83)m

854.39	998.96	1101.11	1167.27	1187.92	1143.80	1103.27	1069.14	1038.56	950.11	848.31	806.45	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

	0.98	0.95	0.89	0.77	0.61	0.43	0.31	0.33	0.52	0.80	0.95	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

	20.47	20.64	20.81	20.94	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.21	20.21	20.21	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.22	20.22	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.87	0.73	0.56	0.38	0.26	0.28	0.46	0.75	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.52	19.76	19.99	20.16	20.22	20.24	20.24	20.24	20.23	20.16	19.85	19.47	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.83	20.05	20.26	20.42	20.47	20.49	20.49	20.49	20.49	20.42	20.13	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.83	20.05	20.26	20.42	20.47	20.49	20.49	20.49	20.49	20.42	20.13	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.74	0.57	0.40	0.27	0.30	0.48	0.76	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	830.06	934.74	955.29	863.90	682.62	455.98	301.59	316.15	496.16	726.34	794.27	788.88	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1254.25	1219.69	1104.31	910.01	690.90	456.58	301.63	316.22	498.14	773.27	1032.52	1243.32	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	315.59	191.49	110.87	33.20	6.16	0.00	0.00	0.00	0.00	34.91	171.54	338.10	

∑(98)1...5, 10...12 = 1201.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.65 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1201.88		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1261.97	(307a)

Water heating

Annual water heating requirement	1900.46		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1995.48	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	32.57	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3839.84	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1261.97	x	4.24	x 0.01 =	53.51	(340a)
Water heating from boilers	1995.48	x	4.24	x 0.01 =	84.61	(342a)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		334.93	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	85.98	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3344.41	x	0.216	=	722.39	(367)
Electrical energy for community heat distribution	32.57	x	0.519	=	16.91	(372)
Total CO2 associated with community systems					739.30	(373)
Total CO2 associated with space and water heating					739.30	(376)
Pumps and fans	191.96	x	0.519	=	99.63	(378)
Electricity for lighting	390.43	x	0.519	=	202.63	(379)
Total CO_2, kg/year				(376)..(382) =	1041.56	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.96	(384)
EI value					90.03	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3344.41	x	1.22	=	4080.18	(367)
Electrical energy for community heat distribution	32.57	x	3.07	=	100.00	(372)
Total primary energy associated with community systems					4180.18	(373)
Total primary energy associated with space and water heating					4180.18	(376)

Pumps and fans	191.96	x	3.07	=	589.32	(378)
Electricity for lighting	390.43	x	3.07	=	1198.62	(379)
Primary energy kWh/year					5968.12	(383)
Dwelling primary energy rate kWh/m2/year					62.82	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ir 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			45.47	x	0.15	=	6.82			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Roof			67.20	x	0.12	=	8.06			(30)
Total area of external elements ∑A, m²			133.45							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.12 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.02 (36)
Total fabric heat loss	(33) + (36) =	60.14 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

80.75	80.50	80.25	79.00	78.75	77.51	77.51	77.26	78.00	78.75	79.25	79.75	

Average = ∑(39)1...12/12 = 78.94 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.85	0.84	0.83	0.83	0.82	0.82	0.81	0.82	0.83	0.83	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.23 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.23 (50)
Enter (50) or (54) in (55)	0.23 (55)

Water storage loss calculated for each month (55) x (41)m

7.13	6.44	7.13	6.90	7.13	6.90	7.13	7.13	6.90	7.13	6.90	7.13	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

7.13	6.44	7.13	6.90	7.13	6.90	7.13	7.13	6.90	7.13	6.90	7.13	(57)

Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss for each month from Table 3a, 3b or 3c

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

	190.33	167.33	174.74	155.26	151.14	133.61	126.95	141.19	141.53	161.06	172.04	185.28 (62)

Solar DHW input calculated using Appendix G or Appendix H

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (63)

Output from water heater for each month (kWh/month) (62)m + (63)m

	190.33	167.33	174.74	155.26	151.14	133.61	126.95	141.19	141.53	161.06	172.04	185.28

∑(64)1...12 = 1900.46 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

	77.49	68.47	72.31	65.37	64.46	58.18	56.42	61.15	60.81	67.76	70.95	75.81 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	104.16	101.89	97.19	90.80	86.64	80.80	75.83	82.20	84.46	91.08	98.55	101.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	637.13	632.53	608.98	572.28	534.49	500.68	480.92	489.62	510.73	547.65	588.76	620.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

	217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37 (83)

Total gains - internal and solar (73)m + (83)m

	854.39	998.96	1101.11	1167.27	1187.92	1143.80	1103.27	1069.14	1038.56	950.11	848.31	806.45 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

	0.98	0.95	0.89	0.77	0.61	0.43	0.31	0.33	0.52	0.80	0.95	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

	20.47	20.64	20.81	20.94	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.21	20.21	20.21	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.22	20.22	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.87	0.73	0.56	0.38	0.26	0.28	0.46	0.75	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.52	19.76	19.99	20.16	20.22	20.24	20.24	20.24	20.23	20.16	19.85	19.47	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.83	20.05	20.26	20.42	20.47	20.49	20.49	20.49	20.49	20.42	20.13	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.83	20.05	20.26	20.42	20.47	20.49	20.49	20.49	20.49	20.42	20.13	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.74	0.57	0.40	0.27	0.30	0.48	0.76	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	830.06	934.74	955.29	863.90	682.62	455.98	301.59	316.15	496.16	726.34	794.27	788.88	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1254.25	1219.69	1104.31	910.01	690.90	456.58	301.63	316.22	498.14	773.27	1032.52	1243.32	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	315.59	191.49	110.87	33.20	6.16	0.00	0.00	0.00	0.00	34.91	171.54	338.10	

∑(98)1...5, 10...12 = 1201.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.65 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1201.88		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	252.39	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1009.58	(307b)

Water heating

Annual water heating requirement	1900.46		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	399.10	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1596.39	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	32.57	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3839.84	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	252.39	x	2.97	x 0.01 =	7.50	(340a)
Space heating from boilers	1009.58	x	4.24	x 0.01 =	42.81	(340b)
Water heating from CHP	399.10	x	2.97	x 0.01 =	11.85	(342a)
Water heating from boilers	1596.39	x	4.24	x 0.01 =	67.69	(342b)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		326.66	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.98	(357)
SAP value	86.33	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	467.0145	x	0.2160	=	100.8751	(363)
less credit emissions for electricity		-154.8428	x	0.5190	=	-80.3634	(364)
Water heated by CHP		738.4647	x	0.2160	=	159.5084	(365)
less credit emissions for electricity		-244.8446	x	0.5190	=	-127.0743	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2675.53	x	0.216	=	577.91	(368)
Electrical energy for community heat distribution		32.57	x	0.519	=	16.91	(372)
Total CO2 associated with community systems						647.77	(373)
Total CO2 associated with space and water heating						647.77	(376)
Pumps and fans		191.96	x	0.519	=	99.63	(378)
Electricity for lighting		390.43	x	0.519	=	202.63	(379)
Total CO_2, kg/year					(376)..(382) =	950.03	(383)

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Dwelling CO_2 emission rate	(383) ÷ (4) =	10.00	(384)
EI value		90.91	
EI rating (section 14)		91	(385)
EI band		B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	467.01	x	1.22	=	569.76	(363)
less credit energy for electricity		-154.84	x	3.07	=	-475.37	(364)
Water heated by CHP		738.46	x	1.22	=	900.93	(365)
less credit energy for electricity		-244.84	x	3.07	=	-751.67	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2675.53	x	1.22	=	3264.14	(368)
Electrical energy for community heat distribution		32.57	x	3.07	=	100.00	(372)
Total primary energy associated with community systems						3607.79	(373)
Total primary energy associated with space and water heating						3607.79	(376)
Pumps and fans		191.96	x	3.07	=	589.32	(378)
Electricity for lighting		390.43	x	3.07	=	1198.62	(379)
Primary energy kWh/year						5395.73	(383)
Dwelling primary energy rate kWh/m2/year						56.80	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Ir 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			45.47	x	0.15	=	6.82			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Roof			67.20	x	0.12	=	8.06			(30)
Total area of external elements ∑A, m²			133.45							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.12 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.02 (36)
Total fabric heat loss	(33) + (36) =	60.14 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

80.75	80.50	80.25	79.00	78.75	77.51	77.51	77.26	78.00	78.75	79.25	79.75	

Average = ∑(39)1...12/12 = 78.94 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.85	0.84	0.83	0.83	0.82	0.82	0.81	0.82	0.83	0.83	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss for each month from Table 3a, 3b or 3c

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

	192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14 (62)

Solar DHW input calculated using Appendix G or Appendix H

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (63)

Output from water heater for each month (kWh/month) (62)m + (63)m

	192.19	169.01	176.60	157.06	153.00	135.41	128.81	143.05	143.33	162.92	173.84	187.14

∑(64)1...12 = 1922.36 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

	78.98	69.82	73.80	66.81	65.95	59.62	57.91	62.64	62.25	69.25	72.39	77.30 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	106.16	103.89	99.19	92.80	88.64	82.80	77.83	84.20	86.46	93.08	100.55	103.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	639.13	634.53	610.98	574.28	536.49	502.68	482.92	491.62	512.73	549.65	590.76	622.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

	217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37 (83)

Total gains - internal and solar (73)m + (83)m

	856.39	1000.96	1103.11	1169.27	1189.92	1145.80	1105.27	1071.14	1040.56	952.11	850.31	808.45 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

	0.98	0.95	0.89	0.77	0.61	0.43	0.31	0.33	0.51	0.79	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

	20.47	20.64	20.81	20.94	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.21	20.21	20.21	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.22	20.22	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.87	0.73	0.56	0.38	0.26	0.28	0.46	0.75	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.52	19.76	19.99	20.16	20.22	20.24	20.24	20.24	20.23	20.16	19.85	19.48	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.83	20.05	20.26	20.42	20.47	20.49	20.49	20.49	20.49	20.42	20.13	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.83	20.05	20.26	20.42	20.47	20.49	20.49	20.49	20.49	20.42	20.13	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.74	0.57	0.40	0.27	0.30	0.48	0.76	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	831.75	936.11	956.21	864.28	682.70	455.99	301.59	316.16	496.18	726.79	795.64	790.63	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1254.44	1219.84	1104.41	910.05	690.91	456.58	301.63	316.22	498.14	773.31	1032.67	1243.52	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	314.48	190.67	110.26	32.96	6.11	0.00	0.00	0.00	0.00	34.61	170.66	336.95	

∑(98)1...5, 10...12 = 1196.70 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.60 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1196.70		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	251.31	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1005.23	(307b)

Water heating

Annual water heating requirement	1922.36		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	403.70	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1614.78	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	32.75	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3624.23	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	251.31	x	2.97	x 0.01 =	7.46	(340a)
Space heating from boilers	1005.23	x	4.24	x 0.01 =	42.62	(340b)
Water heating from CHP	403.70	x	2.97	x 0.01 =	11.99	(342a)
Water heating from boilers	1614.78	x	4.24	x 0.01 =	68.47	(342b)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		327.36	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.98	(357)
SAP value	86.30	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	465.0039	x	0.2160	=	100.4409	(363)
less credit emissions for electricity		-154.1762	x	0.5190	=	-80.0175	(364)
Water heated by CHP		746.9744	x	0.2160	=	161.3465	(365)
less credit emissions for electricity		-247.6660	x	0.5190	=	-128.5387	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2689.95	x	0.216	=	581.03	(368)
Electrical energy for community heat distribution		32.75	x	0.519	=	17.00	(372)
Total CO2 associated with community systems						651.26	(373)

Total CO2 associated with space and water heating					651.26	(376)
Pumps and fans	191.96	x	0.519	=	99.63	(378)
Electricity for lighting	390.43	x	0.519	=	202.63	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	832.50	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	8.76	(384)
EI value					92.03	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	465.00	x	1.22	=	567.30	(363)
less credit energy for electricity		-154.18	x	3.07	=	-473.32	(364)
Water heated by CHP		746.97	x	1.22	=	911.31	(365)
less credit energy for electricity		-247.67	x	3.07	=	-760.33	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2689.95	x	1.22	=	3281.74	(368)
Electrical energy for community heat distribution		32.75	x	3.07	=	100.54	(372)
Total primary energy associated with community systems						3627.24	(373)
Total primary energy associated with space and water heating						3627.24	(376)
Pumps and fans		191.96	x	3.07	=	589.32	(378)
Electricity for lighting		390.43	x	3.07	=	1198.62	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						4699.32	(383)
Dwelling primary energy rate kWh/m2/year						49.47	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Jf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
Exposed floor			72.30	x	0.10	=	7.23			(28b
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			114.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.22 (36)
Total fabric heat loss	(33) + (36) =	48.74 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

64.43	64.24	64.05	63.10	62.91	61.96	61.96	61.77	62.34	62.91	63.29	63.67	

Average = ∑(39)1...12/12 = 63.05 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.89	0.89	0.89	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.88	0.88	

Average = ∑(40)1...12/12 = 0.87 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.87	0.72	0.55	0.39	0.28	0.31	0.49	0.78	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.46	20.64	20.82	20.95	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.18	20.18	20.18	20.19	20.19	20.20	20.20	20.21	20.20	20.19	20.19	20.18	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.84	0.69	0.51	0.34	0.23	0.25	0.43	0.73	0.93	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.49	19.73	19.97	20.14	20.19	20.20	20.20	20.21	20.20	20.13	19.82	19.44	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.85	20.07	20.29	20.44	20.49	20.50	20.50	20.50	20.50	20.43	20.14	19.81	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.85	20.07	20.29	20.44	20.49	20.50	20.50	20.50	20.50	20.43	20.14	19.81	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.93	0.85	0.70	0.52	0.36	0.25	0.27	0.45	0.75	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	675.08	754.06	773.93	698.60	548.02	365.27	241.70	253.38	397.26	582.04	641.24	643.58	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1001.91	974.26	882.95	728.20	552.73	365.61	241.72	253.42	398.72	618.37	825.41	993.74	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	243.16	147.97	81.12	21.31	3.51	0.00	0.00	0.00	0.00	27.03	132.60	260.52	

∑(98)1...5, 10...12 = 917.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.69 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	917.22		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	963.08	(307a)

Water heating

Annual water heating requirement	1777.55		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1866.43	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.30	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	110.26	(330a)

Total electricity for the above, kWh/year		110.26	(331)
Electricity for lighting (Appendix L)		318.99	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3258.75	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	963.08	x	4.24	x 0.01 =	40.83	(340a)
Water heating from boilers	1866.43	x	4.24	x 0.01 =	79.14	(342a)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		296.59	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.06	(357)
SAP value	85.19	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2905.04	x	0.216	=	627.49	(367)
Electrical energy for community heat distribution		28.30	x	0.519	=	14.69	(372)
Total CO2 associated with community systems						642.17	(373)
Total CO2 associated with space and water heating						642.17	(376)
Pumps and fans		110.26	x	0.519	=	57.22	(378)
Electricity for lighting		318.99	x	0.519	=	165.55	(379)
Total CO_2, kg/year					(376)..(382) =	864.95	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.96	(384)
EI value						90.12	
EI rating (section 14)						90	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2905.04	x	1.22	=	3544.15	(367)
Electrical energy for community heat distribution		28.30	x	3.07	=	86.87	(372)
Total primary energy associated with community systems						3631.01	(373)
Total primary energy associated with space and water heating						3631.01	(376)
Pumps and fans		110.26	x	3.07	=	338.49	(378)
Electricity for lighting		318.99	x	3.07	=	979.29	(379)
Primary energy kWh/year						4948.79	(383)

Dwelling primary energy rate kWh/m2/year	68.45	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Jf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
Exposed floor			72.30	x	0.10	=	7.23			(28b
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			114.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.22 (36)
Total fabric heat loss	(33) + (36) =	48.74 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

64.43	64.24	64.05	63.10	62.91	61.96	61.96	61.77	62.34	62.91	63.29	63.67	

Average = ∑(39)1...12/12 = 63.05 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.89	0.89	0.89	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.88	0.88	

Average = ∑(40)1...12/12 = 0.87 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.87	0.72	0.55	0.39	0.28	0.31	0.49	0.78	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.46	20.64	20.82	20.95	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.18	20.18	20.18	20.19	20.19	20.20	20.20	20.21	20.20	20.19	20.19	20.18	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.84	0.69	0.51	0.34	0.23	0.25	0.43	0.73	0.93	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.49	19.73	19.97	20.14	20.19	20.20	20.20	20.21	20.20	20.13	19.82	19.44	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.85	20.07	20.29	20.44	20.49	20.50	20.50	20.50	20.50	20.43	20.14	19.81	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.85	20.07	20.29	20.44	20.49	20.50	20.50	20.50	20.50	20.43	20.14	19.81	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.93	0.85	0.70	0.52	0.36	0.25	0.27	0.45	0.75	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	675.08	754.06	773.93	698.60	548.02	365.27	241.70	253.38	397.26	582.04	641.24	643.58	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1001.91	974.26	882.95	728.20	552.73	365.61	241.72	253.42	398.72	618.37	825.41	993.74	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	243.16	147.97	81.12	21.31	3.51	0.00	0.00	0.00	0.00	27.03	132.60	260.52	

∑(98)1...5, 10...12 = 917.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.69 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	917.22		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	192.62	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	770.46	(307b)

Water heating

Annual water heating requirement	1777.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	373.29	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1493.14	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.30	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	110.26		(330a)
Total electricity for the above, kWh/year		110.26	(331)
Electricity for lighting (Appendix L)		318.99	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3258.75	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	192.62	x	2.97	x 0.01 =	5.72	(340a)
Space heating from boilers	770.46	x	4.24	x 0.01 =	32.67	(340b)
Water heating from CHP	373.29	x	2.97	x 0.01 =	11.09	(342a)
Water heating from boilers	1493.14	x	4.24	x 0.01 =	63.31	(342b)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		289.40	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.54	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	356.4056	x	0.2160	=	76.9836	(363)
less credit emissions for electricity		-118.1695	x	0.5190	=	-61.3300	(364)
Water heated by CHP		690.7051	x	0.2160	=	149.1923	(365)
less credit emissions for electricity		-229.0095	x	0.5190	=	-118.8559	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2324.03	x	0.216	=	501.99	(368)
Electrical energy for community heat distribution		28.30	x	0.519	=	14.69	(372)
Total CO2 associated with community systems						562.67	(373)
Total CO2 associated with space and water heating						562.67	(376)
Pumps and fans		110.26	x	0.519	=	57.22	(378)
Electricity for lighting		318.99	x	0.519	=	165.55	(379)
Total CO_2, kg/year					(376)..(382) =	785.44	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.86	(384)
EI value						91.03	
EI rating (section 14)						91	(385)

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EI band | B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	356.41	x	1.22	=	434.81	(363)
less credit energy for electricity		-118.17	x	3.07	=	-362.78	(364)
Water heated by CHP		690.71	x	1.22	=	842.66	(365)
less credit energy for electricity		-229.01	x	3.07	=	-703.06	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2324.03	x	1.22	=	2835.32	(368)
Electrical energy for community heat distribution		28.30	x	3.07	=	86.87	(372)
Total primary energy associated with community systems						3133.82	(373)
Total primary energy associated with space and water heating						3133.82	(376)
Pumps and fans		110.26	x	3.07	=	338.49	(378)
Electricity for lighting		318.99	x	3.07	=	979.29	(379)
Primary energy kWh/year						4451.60	(383)
Dwelling primary energy rate kWh/m2/year						61.57	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Jf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
Exposed floor			72.30	x	0.10	=	7.23			(28b
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			114.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.52 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.22 (36)
Total fabric heat loss	(33) + (36) =	48.74 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

64.43	64.24	64.05	63.10	62.91	61.96	61.96	61.77	62.34	62.91	63.29	63.67	

Average = ∑(39)1...12/12 = 63.05 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.89	0.89	0.89	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.88	0.88	

Average = ∑(40)1...12/12 = 0.87 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.94	0.87	0.72	0.55	0.39	0.28	0.31	0.49	0.78	0.94	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.46	20.64	20.82	20.95	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.18	20.18	20.18	20.19	20.19	20.20	20.20	20.21	20.20	20.19	20.19	20.18	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.84	0.69	0.51	0.34	0.23	0.25	0.43	0.73	0.93	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.49	19.73	19.97	20.14	20.19	20.20	20.20	20.21	20.20	20.13	19.82	19.44	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.85	20.07	20.29	20.44	20.49	20.50	20.50	20.50	20.50	20.43	20.14	19.81	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.85	20.07	20.29	20.44	20.49	20.50	20.50	20.50	20.50	20.43	20.14	19.81	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.93	0.85	0.70	0.52	0.36	0.25	0.27	0.45	0.75	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	675.08	754.06	773.93	698.60	548.02	365.27	241.70	253.38	397.26	582.04	641.24	643.58	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1001.91	974.26	882.95	728.20	552.73	365.61	241.72	253.42	398.72	618.37	825.41	993.74	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	243.16	147.97	81.12	21.31	3.51	0.00	0.00	0.00	0.00	27.03	132.60	260.52	

∑(98)1...5, 10...12 = 917.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.69 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	917.22		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	192.62	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	770.46	(307b)

Water heating

Annual water heating requirement	1777.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	373.29	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1493.14	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.30	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	110.26		(330a)
Total electricity for the above, kWh/year		110.26	(331)
Electricity for lighting (Appendix L)		318.99	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3025.57	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	192.62	x	2.97	x 0.01 =	5.72	(340a)
Space heating from boilers	770.46	x	4.24	x 0.01 =	32.67	(340b)
Water heating from CHP	373.29	x	2.97	x 0.01 =	11.09	(342a)
Water heating from boilers	1493.14	x	4.24	x 0.01 =	63.31	(342b)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		289.40	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.54	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	356.4056	x	0.2160	=	76.9836	(363)
less credit emissions for electricity		-118.1695	x	0.5190	=	-61.3300	(364)
Water heated by CHP		690.7051	x	0.2160	=	149.1923	(365)
less credit emissions for electricity		-229.0095	x	0.5190	=	-118.8559	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2324.03	x	0.216	=	501.99	(368)
Electrical energy for community heat distribution		28.30	x	0.519	=	14.69	(372)
Total CO2 associated with community systems						562.67	(373)
Total CO2 associated with space and water heating						562.67	(376)
Pumps and fans		110.26	x	0.519	=	57.22	(378)
Electricity for lighting		318.99	x	0.519	=	165.55	(379)

Energy saving/generation technologies							
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	664.42	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.19	(384)
EI value					92.41	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	356.41	x	1.22	=	434.81	(363)
less credit energy for electricity		-118.17	x	3.07	=	-362.78	(364)
Water heated by CHP		690.71	x	1.22	=	842.66	(365)
less credit energy for electricity		-229.01	x	3.07	=	-703.06	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2324.03	x	1.22	=	2835.32	(368)
Electrical energy for community heat distribution		28.30	x	3.07	=	86.87	(372)
Total primary energy associated with community systems						3133.82	(373)
Total primary energy associated with space and water heating						3133.82	(376)
Pumps and fans		110.26	x	3.07	=	338.49	(378)
Electricity for lighting		318.99	x	3.07	=	979.29	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3735.74	(383)
Dwelling primary energy rate kWh/m2/year						51.67	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Jo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			42.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.29 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.38 (36)
Total fabric heat loss	(33) + (36) =	30.66 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.36	46.17	45.98	45.02	44.83	43.88	43.88	43.69	44.26	44.83	45.21	45.60	

Average = ∑(39)1...12/12 = 44.98 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.64	0.64	0.64	0.62	0.62	0.61	0.61	0.60	0.61	0.62	0.63	0.63	

Average = ∑(40)1...12/12 = 0.62 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.85	0.71	0.54	0.40	0.28	0.20	0.22	0.35	0.60	0.85	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.82	20.92	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.80	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.39	20.40	20.40	20.41	20.41	20.42	20.42	20.43	20.42	20.41	20.41	20.40	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.92	0.83	0.69	0.52	0.37	0.25	0.17	0.19	0.32	0.56	0.82	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.18	20.31	20.38	20.41	20.41	20.42	20.42	20.43	20.42	20.41	20.34	20.15	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.42	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.56	20.39	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.42	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.56	20.39	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.83	0.70	0.53	0.38	0.26	0.18	0.20	0.33	0.57	0.83	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	642.67	676.85	636.98	526.91	400.36	265.01	177.24	185.28	289.29	447.79	573.20	618.87	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	747.15	721.87	648.34	528.05	400.44	265.01	177.25	185.28	289.31	449.61	608.68	738.33	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	77.74	30.25	8.45	0.82	0.05	0.00	0.00	0.00	0.00	1.36	25.55	88.88	

∑(98)1...5, 10...12 = 233.09 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.22 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11) — '0' if none = 0.00 (301)

Fraction of space heat from community system — 1 - (301) = 1.00 (302)

Fraction of community heat from boilers — 1.00 (303a)

Fraction of total space heat from community boilers — (302) x (303a) = 1.00 (304a)

Factor for control and charging method (Table 4c(3)) for community space heating — 1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating — 1.00 (305a)

Distribution loss factor (Table 12c) for community heating system — 1.05 (306)

Space heating

Annual space heating requirement — 233.09 (98)

Space heat from boilers — (98) x (304a) x (305) x (306) = 244.75 (307a)

Water heating

Annual water heating requirement — 1777.55 (64)

Water heat from boilers — (64) x (303a) x (305a) x (306) = 1866.43 (310a)

Electricity used for heat distribution — 0.01 × [(307a)...(307e) + (310a)...(310e)] = 21.11 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside — 110.26 (330a)

Total electricity for the above, kWh/year — 110.26 (331)

Electricity for lighting (Appendix L)		318.99	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2540.42	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	244.75	x	4.24	x 0.01 =	10.38	(340a)
Water heating from boilers	1866.43	x	4.24	x 0.01 =	79.14	(342a)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		266.13	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.95	(357)
SAP value	86.71	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2167.53	x	0.216	=	468.19	(367)
Electrical energy for community heat distribution	21.11	x	0.519	=	10.96	(372)
Total CO2 associated with community systems					479.14	(373)
Total CO2 associated with space and water heating					479.14	(376)
Pumps and fans	110.26	x	0.519	=	57.22	(378)
Electricity for lighting	318.99	x	0.519	=	165.55	(379)
Total CO_2, kg/year				(376)..(382) =	701.92	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.71	(384)
EI value					91.98	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2167.53	x	1.22	=	2644.39	(367)
Electrical energy for community heat distribution	21.11	x	3.07	=	64.81	(372)
Total primary energy associated with community systems					2709.20	(373)
Total primary energy associated with space and water heating					2709.20	(376)
Pumps and fans	110.26	x	3.07	=	338.49	(378)
Electricity for lighting	318.99	x	3.07	=	979.29	(379)
Primary energy kWh/year					4026.98	(383)
Dwelling primary energy rate kWh/m2/year					55.70	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Jo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			42.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.29 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.38 (36)
Total fabric heat loss	(33) + (36) =	30.66 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.36	46.17	45.98	45.02	44.83	43.88	43.88	43.69	44.26	44.83	45.21	45.60	

Average = ∑(39)1...12/12 = 44.98 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.64	0.64	0.64	0.62	0.62	0.61	0.61	0.60	0.61	0.62	0.63	0.63	

Average = ∑(40)1...12/12 = 0.62 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.85	0.71	0.54	0.40	0.28	0.20	0.22	0.35	0.60	0.85	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.82	20.92	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.80	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.39	20.40	20.40	20.41	20.41	20.42	20.42	20.43	20.42	20.41	20.41	20.40	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.92	0.83	0.69	0.52	0.37	0.25	0.17	0.19	0.32	0.56	0.82	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.18	20.31	20.38	20.41	20.41	20.42	20.42	20.43	20.42	20.41	20.34	20.15	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.42	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.56	20.39	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.42	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.56	20.39	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.83	0.70	0.53	0.38	0.26	0.18	0.20	0.33	0.57	0.83	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	642.67	676.85	636.98	526.91	400.36	265.01	177.24	185.28	289.29	447.79	573.20	618.87	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	747.15	721.87	648.34	528.05	400.44	265.01	177.25	185.28	289.31	449.61	608.68	738.33	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	77.74	30.25	8.45	0.82	0.05	0.00	0.00	0.00	0.00	1.36	25.55	88.88	

∑(98)1...5, 10...12 = 233.09 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.22 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	233.09		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	48.95	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	195.80	(307b)

Water heating

Annual water heating requirement	1777.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	373.29	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1493.14	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	21.11	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	110.26		(330a)
Total electricity for the above, kWh/year		110.26	(331)
Electricity for lighting (Appendix L)		318.99	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2540.42	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	48.95	x	2.97	x 0.01 =	1.45	(340a)
Space heating from boilers	195.80	x	4.24	x 0.01 =	8.30	(340b)
Water heating from CHP	373.29	x	2.97	x 0.01 =	11.09	(342a)
Water heating from boilers	1493.14	x	4.24	x 0.01 =	63.31	(342b)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		260.77	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.93	(357)
SAP value	86.97	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	90.5727	x	0.2160	=	19.5637	(363)
less credit emissions for electricity		-30.0302	x	0.5190	=	-15.5857	(364)
Water heated by CHP		690.7051	x	0.2160	=	149.1923	(365)
less credit emissions for electricity		-229.0095	x	0.5190	=	-118.8559	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1734.02	x	0.216	=	374.55	(368)
Electrical energy for community heat distribution		21.11	x	0.519	=	10.96	(372)
Total CO2 associated with community systems						419.82	(373)
Total CO2 associated with space and water heating						419.82	(376)
Pumps and fans		110.26	x	0.519	=	57.22	(378)
Electricity for lighting		318.99	x	0.519	=	165.55	(379)
Total CO_2, kg/year					(376)..(382) =	642.60	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	8.89	(384)
EI value						92.66	
EI rating (section 14)						93	(385)
EI band						A	

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13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	90.57	x	1.22	=	110.50	(363)
less credit energy for electricity		-30.03	x	3.07	=	-92.19	(364)
Water heated by CHP		690.71	x	1.22	=	842.66	(365)
less credit energy for electricity		-229.01	x	3.07	=	-703.06	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1734.02	x	1.22	=	2115.51	(368)
Electrical energy for community heat distribution		21.11	x	3.07	=	64.81	(372)
Total primary energy associated with community systems						2338.23	(373)
Total primary energy associated with space and water heating						2338.23	(376)
Pumps and fans		110.26	x	3.07	=	338.49	(378)
Electricity for lighting		318.99	x	3.07	=	979.29	(379)
Primary energy kWh/year						3656.01	(383)
Dwelling primary energy rate kWh/m2/year						50.57	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Jo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			42.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.29 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.38 (36)
Total fabric heat loss	(33) + (36) =	30.66 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.36	46.17	45.98	45.02	44.83	43.88	43.88	43.69	44.26	44.83	45.21	45.60	

Average = ∑(39)1...12/12 = 44.98 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.64	0.64	0.64	0.62	0.62	0.61	0.61	0.60	0.61	0.62	0.63	0.63	

Average = ∑(40)1...12/12 = 0.62 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.93	0.85	0.71	0.54	0.40	0.28	0.20	0.22	0.35	0.60	0.85	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.82	20.92	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.80	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.39	20.40	20.40	20.41	20.41	20.42	20.42	20.43	20.42	20.41	20.41	20.40	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.92	0.83	0.69	0.52	0.37	0.25	0.17	0.19	0.32	0.56	0.82	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.18	20.31	20.38	20.41	20.41	20.42	20.42	20.43	20.42	20.41	20.34	20.15	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.42	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.56	20.39	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.42	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.56	20.39	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.83	0.70	0.53	0.38	0.26	0.18	0.20	0.33	0.57	0.83	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	642.67	676.85	636.98	526.91	400.36	265.01	177.24	185.28	289.29	447.79	573.20	618.87	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	747.15	721.87	648.34	528.05	400.44	265.01	177.25	185.28	289.31	449.61	608.68	738.33	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	77.74	30.25	8.45	0.82	0.05	0.00	0.00	0.00	0.00	1.36	25.55	88.88	

∑(98)1...5, 10...12 = 233.09 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.22 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	233.09		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	48.95	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	195.80	(307b)

Water heating

Annual water heating requirement	1777.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	373.29	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1493.14	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	21.11	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	110.26		(330a)
Total electricity for the above, kWh/year		110.26	(331)
Electricity for lighting (Appendix L)		318.99	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2307.24	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	48.95	x	2.97	x 0.01 =	1.45	(340a)
Space heating from boilers	195.80	x	4.24	x 0.01 =	8.30	(340b)
Water heating from CHP	373.29	x	2.97	x 0.01 =	11.09	(342a)
Water heating from boilers	1493.14	x	4.24	x 0.01 =	63.31	(342b)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		260.77	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.93	(357)
SAP value	86.97	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	90.5727	x	0.2160	=	19.5637	(363)
less credit emissions for electricity		-30.0302	x	0.5190	=	-15.5857	(364)
Water heated by CHP		690.7051	x	0.2160	=	149.1923	(365)
less credit emissions for electricity		-229.0095	x	0.5190	=	-118.8559	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1734.02	x	0.216	=	374.55	(368)
Electrical energy for community heat distribution		21.11	x	0.519	=	10.96	(372)
Total CO2 associated with community systems						419.82	(373)
Total CO2 associated with space and water heating						419.82	(376)
Pumps and fans		110.26	x	0.519	=	57.22	(378)
Electricity for lighting		318.99	x	0.519	=	165.55	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	521.58	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.21	(384)
EI value					94.04	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	90.57	x	1.22	=	110.50	(363)
less credit energy for electricity		-30.03	x	3.07	=	-92.19	(364)
Water heated by CHP		690.71	x	1.22	=	842.66	(365)
less credit energy for electricity		-229.01	x	3.07	=	-703.06	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1734.02	x	1.22	=	2115.51	(368)
Electrical energy for community heat distribution		21.11	x	3.07	=	64.81	(372)
Total primary energy associated with community systems						2338.23	(373)
Total primary energy associated with space and water heating						2338.23	(376)
Pumps and fans		110.26	x	3.07	=	338.49	(378)
Electricity for lighting		318.99	x	3.07	=	979.29	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2940.15	(383)
Dwelling primary energy rate kWh/m2/year						40.67	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Jr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Roof			72.30	x	0.12	=	8.68			(30)
Total area of external elements ∑A, m²			114.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.97 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.22 (36)
Total fabric heat loss	(33) + (36) =	50.19 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

65.88	65.69	65.50	64.55	64.36	63.41	63.41	63.21	63.79	64.36	64.74	65.12	

Average = ∑(39)1...12/12 = 64.50 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.91	0.91	0.91	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.90	0.90	

Average = ∑(40)1...12/12 = 0.89 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.94	0.87	0.74	0.57	0.40	0.29	0.31	0.50	0.79	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.43	20.61	20.80	20.94	20.99	21.00	21.00	21.00	21.00	20.92	20.67	20.40	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.16	20.16	20.16	20.17	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.85	0.70	0.52	0.35	0.23	0.26	0.44	0.74	0.93	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.43	19.68	19.93	20.11	20.17	20.19	20.19	20.19	20.18	20.10	19.77	19.38	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.80	20.02	20.25	20.42	20.47	20.49	20.49	20.49	20.48	20.41	20.10	19.76	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.80	20.02	20.25	20.42	20.47	20.49	20.49	20.49	20.48	20.41	20.10	19.76	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.93	0.85	0.71	0.54	0.37	0.25	0.28	0.46	0.76	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	676.06	756.77	780.11	709.15	558.83	373.01	246.65	258.61	405.41	589.61	643.58	644.29	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1021.37	993.44	900.78	743.64	564.63	373.45	246.69	258.67	407.25	631.28	841.84	1013.27	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	256.91	159.04	89.77	24.84	4.31	0.00	0.00	0.00	0.00	31.01	142.75	274.52	

∑(98)1...5, 10...12 = 983.16 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.60 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	983.16		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1032.31	(307a)

Water heating

Annual water heating requirement	1777.55		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1866.43	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.99	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	110.26	(330a)

Total electricity for the above, kWh/year		110.26	(331)
Electricity for lighting (Appendix L)		318.99	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3327.99	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1032.31	x	4.24	x 0.01 =	43.77	(340a)
Water heating from boilers	1866.43	x	4.24	x 0.01 =	79.14	(342a)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		299.52	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.04	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2976.12	x	0.216	=	642.84	(367)
Electrical energy for community heat distribution		28.99	x	0.519	=	15.04	(372)
Total CO2 associated with community systems						657.89	(373)
Total CO2 associated with space and water heating						657.89	(376)
Pumps and fans		110.26	x	0.519	=	57.22	(378)
Electricity for lighting		318.99	x	0.519	=	165.55	(379)
Total CO_2, kg/year					(376)..(382) =	880.66	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.18	(384)
EI value						89.94	
EI rating (section 14)						90	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2976.12	x	1.22	=	3630.87	(367)
Electrical energy for community heat distribution		28.99	x	3.07	=	88.99	(372)
Total primary energy associated with community systems						3719.86	(373)
Total primary energy associated with space and water heating						3719.86	(376)
Pumps and fans		110.26	x	3.07	=	338.49	(378)
Electricity for lighting		318.99	x	3.07	=	979.29	(379)
Primary energy kWh/year						5037.64	(383)

DRAFT

Dwelling primary energy rate kWh/m2/year	69.68	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Jr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Roof			72.30	x	0.12	=	8.68			(30)
Total area of external elements ∑A, m²			114.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.97 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.22 (36)
Total fabric heat loss	(33) + (36) =	50.19 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

65.88	65.69	65.50	64.55	64.36	63.41	63.41	63.21	63.79	64.36	64.74	65.12	

Average = ∑(39)1...12/12 = 64.50 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.91	0.91	0.91	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.90	0.90	

Average = ∑(40)1...12/12 = 0.89 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.94	0.87	0.74	0.57	0.40	0.29	0.31	0.50	0.79	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.43	20.61	20.80	20.94	20.99	21.00	21.00	21.00	21.00	20.92	20.67	20.40	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.16	20.16	20.16	20.17	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.85	0.70	0.52	0.35	0.23	0.26	0.44	0.74	0.93	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.43	19.68	19.93	20.11	20.17	20.19	20.19	20.19	20.18	20.10	19.77	19.38	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.80	20.02	20.25	20.42	20.47	20.49	20.49	20.49	20.48	20.41	20.10	19.76	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.80	20.02	20.25	20.42	20.47	20.49	20.49	20.49	20.48	20.41	20.10	19.76	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.93	0.85	0.71	0.54	0.37	0.25	0.28	0.46	0.76	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	676.06	756.77	780.11	709.15	558.83	373.01	246.65	258.61	405.41	589.61	643.58	644.29	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1021.37	993.44	900.78	743.64	564.63	373.45	246.69	258.67	407.25	631.28	841.84	1013.27	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	256.91	159.04	89.77	24.84	4.31	0.00	0.00	0.00	0.00	31.01	142.75	274.52	

∑(98)1...5, 10...12 = 983.16 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.60 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	983.16		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	206.46	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	825.85	(307b)

Water heating

Annual water heating requirement	1777.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	373.29	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1493.14	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.99	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	110.26		(330a)
Total electricity for the above, kWh/year		110.26	(331)
Electricity for lighting (Appendix L)		318.99	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3327.99	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	206.46	x	2.97	x 0.01 =	6.13	(340a)
Space heating from boilers	825.85	x	4.24	x 0.01 =	35.02	(340b)
Water heating from CHP	373.29	x	2.97	x 0.01 =	11.09	(342a)
Water heating from boilers	1493.14	x	4.24	x 0.01 =	63.31	(342b)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		292.16	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.41	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	382.0268	x	0.2160	=	82.5178	(363)
less credit emissions for electricity		-126.6644	x	0.5190	=	-65.7388	(364)
Water heated by CHP		690.7051	x	0.2160	=	149.1923	(365)
less credit emissions for electricity		-229.0095	x	0.5190	=	-118.8559	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2380.90	x	0.216	=	514.27	(368)
Electrical energy for community heat distribution		28.99	x	0.519	=	15.04	(372)
Total CO2 associated with community systems						576.43	(373)
Total CO2 associated with space and water heating						576.43	(376)
Pumps and fans		110.26	x	0.519	=	57.22	(378)
Electricity for lighting		318.99	x	0.519	=	165.55	(379)
Total CO_2, kg/year					(376)..(382) =	799.21	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.05	(384)
EI value						90.87	
EI rating (section 14)						91	(385)

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EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	382.03	x	1.22	=	466.07	(363)
less credit energy for electricity		-126.66	x	3.07	=	-388.86	(364)
Water heated by CHP		690.71	x	1.22	=	842.66	(365)
less credit energy for electricity		-229.01	x	3.07	=	-703.06	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2380.90	x	1.22	=	2904.69	(368)
Electrical energy for community heat distribution		28.99	x	3.07	=	88.99	(372)
Total primary energy associated with community systems						3210.50	(373)
Total primary energy associated with space and water heating						3210.50	(376)
Pumps and fans		110.26	x	3.07	=	338.49	(378)
Electricity for lighting		318.99	x	3.07	=	979.29	(379)
Primary energy kWh/year						4528.28	(383)
Dwelling primary energy rate kWh/m2/year						62.63	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Jr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.30	(1a) x	2.50	(2a) =	180.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.30	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	180.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.50	x	1.24	=	20.39			(27)
External wall			26.00	x	0.15	=	3.90			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Roof			72.30	x	0.12	=	8.68			(30)
Total area of external elements ∑A, m²			114.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.97 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.22 (36)
Total fabric heat loss	(33) + (36) =	50.19 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.69	15.50	15.31	14.36	14.17	13.22	13.22	13.03	13.60	14.17	14.55	14.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

65.88	65.69	65.50	64.55	64.36	63.41	63.41	63.21	63.79	64.36	64.74	65.12	

Average = ∑(39)1...12/12 = 64.50 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.91	0.91	0.91	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.90	0.90	

Average = ∑(40)1...12/12 = 0.89 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.30 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.84 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.72	94.17	90.62	87.06	83.51	79.96	79.96	83.51	87.06	90.62	94.17	97.72	

∑(44)1...12 = 1066.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

144.92	126.75	130.79	114.03	109.41	94.42	87.49	100.40	101.60	118.40	129.24	140.35	

∑(45)1...12 = 1397.80 (45)

Distribution loss 0.15 x (45)m

21.74	19.01	19.62	17.10	16.41	14.16	13.12	15.06	15.24	17.76	19.39	21.05	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.17	155.88	163.05	145.24	141.67	125.63	119.74	132.65	132.81	150.65	160.46	172.60	

∑(64)1...12 = 1777.55 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.99	65.45	69.29	62.88	62.18	56.36	54.89	59.18	58.75	65.17	67.94	72.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	138.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.16	40.11	32.62	24.69	18.46	15.58	16.84	21.89	29.38	37.30	43.54	46.41	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.39	305.53	297.63	280.79	259.54	239.57	226.23	223.09	231.00	247.83	269.08	289.05	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	51.10	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	-92.03	(71)
Water heating gains (Table 5)	99.45	97.39	93.13	87.34	83.58	78.28	73.78	79.55	81.60	87.59	94.37	97.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	544.11	540.15	520.49	489.94	458.70	430.55	413.96	421.64	439.09	469.84	504.10	529.98	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	6.46	x	46.75	x 0.9 x	0.50	x	0.90	=	94.18	(78)
East	0.77	x	10.04	x	19.64	x 0.9 x	0.50	x	0.90	=	61.49	(76)

Solar gains in watts ∑(74)m...(82)m

155.68	274.54	394.59	511.00	585.50	585.18	562.69	507.74	435.66	309.11	188.32	131.95	(83)

Total gains - internal and solar (73)m + (83)m

699.79	814.70	915.09	1000.94	1044.20	1015.73	976.65	929.38	874.75	778.95	692.41	661.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.94	0.87	0.74	0.57	0.40	0.29	0.31	0.50	0.79	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.43	20.61	20.80	20.94	20.99	21.00	21.00	21.00	21.00	20.92	20.67	20.40	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.16	20.16	20.16	20.17	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.93	0.85	0.70	0.52	0.35	0.23	0.26	0.44	0.74	0.93	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.43	19.68	19.93	20.11	20.17	20.19	20.19	20.19	20.18	20.10	19.77	19.38	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.80	20.02	20.25	20.42	20.47	20.49	20.49	20.49	20.48	20.41	20.10	19.76	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.80	20.02	20.25	20.42	20.47	20.49	20.49	20.49	20.48	20.41	20.10	19.76	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.93	0.85	0.71	0.54	0.37	0.25	0.28	0.46	0.76	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	676.06	756.77	780.11	709.15	558.83	373.01	246.65	258.61	405.41	589.61	643.58	644.29	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1021.37	993.44	900.78	743.64	564.63	373.45	246.69	258.67	407.25	631.28	841.84	1013.27	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	256.91	159.04	89.77	24.84	4.31	0.00	0.00	0.00	0.00	31.01	142.75	274.52	

∑(98)1...5, 10...12 = 983.16 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.60 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	983.16		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	206.46	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	825.85	(307b)

Water heating

Annual water heating requirement	1777.55		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	373.29	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1493.14	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.99	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	110.26		(330a)
Total electricity for the above, kWh/year		110.26	(331)
Electricity for lighting (Appendix L)		318.99	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3094.81	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	206.46	x	2.97	x 0.01 =	6.13	(340a)
Space heating from boilers	825.85	x	4.24	x 0.01 =	35.02	(340b)
Water heating from CHP	373.29	x	2.97	x 0.01 =	11.09	(342a)
Water heating from boilers	1493.14	x	4.24	x 0.01 =	63.31	(342b)
Pumps and fans	110.26	x	13.19	x 0.01 =	14.54	(349)
Electricity for lighting	318.99	x	13.19	x 0.01 =	42.07	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		292.16	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.41	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	382.0268	x	0.2160	=	82.5178	(363)
less credit emissions for electricity		-126.6644	x	0.5190	=	-65.7388	(364)
Water heated by CHP		690.7051	x	0.2160	=	149.1923	(365)
less credit emissions for electricity		-229.0095	x	0.5190	=	-118.8559	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2380.90	x	0.216	=	514.27	(368)
Electrical energy for community heat distribution		28.99	x	0.519	=	15.04	(372)
Total CO2 associated with community systems						576.43	(373)
Total CO2 associated with space and water heating						576.43	(376)
Pumps and fans		110.26	x	0.519	=	57.22	(378)
Electricity for lighting		318.99	x	0.519	=	165.55	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	678.19	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.38	(384)
EI value					92.25	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	382.03	x	1.22	=	466.07	(363)
less credit energy for electricity		-126.66	x	3.07	=	-388.86	(364)
Water heated by CHP		690.71	x	1.22	=	842.66	(365)
less credit energy for electricity		-229.01	x	3.07	=	-703.06	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2380.90	x	1.22	=	2904.69	(368)
Electrical energy for community heat distribution		28.99	x	3.07	=	88.99	(372)
Total primary energy associated with community systems						3210.50	(373)
Total primary energy associated with space and water heating						3210.50	(376)
Pumps and fans		110.26	x	3.07	=	338.49	(378)
Electricity for lighting		318.99	x	3.07	=	979.29	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3812.42	(383)
Dwelling primary energy rate kWh/m2/year						52.73	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Kf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
Exposed floor			50.20	x	0.10	=	5.02			(28b
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			82.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.17 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		12.41 (36)
Total fabric heat loss	(33) + (36) =	35.58 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.47	46.34	46.21	45.55	45.42	44.76	44.76	44.63	45.02	45.42	45.68	45.95	

Average = ∑(39)1...12/12 = 45.52 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.93	0.92	0.92	0.91	0.90	0.89	0.89	0.89	0.90	0.90	0.91	0.92	

Average = ∑(40)1...12/12 = 0.91 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.95	0.87	0.71	0.53	0.37	0.26	0.30	0.49	0.79	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.43	20.59	20.79	20.95	20.99	21.00	21.00	21.00	21.00	20.92	20.66	20.40	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.15	20.15	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.93	0.85	0.67	0.48	0.32	0.21	0.24	0.44	0.75	0.93	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.42	19.64	19.91	20.11	20.16	20.17	20.17	20.18	20.17	20.08	19.75	19.38	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.90	20.09	20.33	20.51	20.56	20.57	20.57	20.57	20.56	20.48	20.18	19.87	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.90	20.09	20.33	20.51	20.56	20.57	20.57	20.57	20.56	20.48	20.18	19.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.93	0.85	0.69	0.50	0.34	0.24	0.27	0.46	0.77	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	480.48	528.35	551.42	506.67	399.01	266.91	177.63	186.06	289.59	415.79	453.06	460.66	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	725.12	704.12	639.24	528.76	402.20	267.14	177.65	186.10	291.00	448.81	597.64	719.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	182.01	118.12	65.33	15.91	2.37	0.00	0.00	0.00	0.00	24.56	104.09	192.79	

∑(98)1...5, 10...12 = 705.20 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.05 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11) — '0' if none = 0.00 (301)

Fraction of space heat from community system — 1 - (301) = 1.00 (302)

Fraction of community heat from boilers — 1.00 (303a)

Fraction of total space heat from community boilers — (302) x (303a) = 1.00 (304a)

Factor for control and charging method (Table 4c(3)) for community space heating — 1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating — 1.00 (305a)

Distribution loss factor (Table 12c) for community heating system — 1.05 (306)

Space heating

Annual space heating requirement — 705.20 (98)

Space heat from boilers — (98) x (304a) x (305) x (306) = 740.46 (307a)

Water heating

Annual water heating requirement — 1551.60 (64)

Water heat from boilers — (64) x (303a) x (305a) x (306) = 1629.18 (310a)

Electricity used for heat distribution — 0.01 × [(307a)...(307e) + (310a)...(310e)] = 23.70 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside — 76.56 (330a)

Total electricity for the above, kWh/year — 76.56 (331)

Electricity for lighting (Appendix L)		232.63	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2678.82	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	740.46	x	4.24	x 0.01 =	31.40	(340a)
Water heating from boilers	1629.18	x	4.24	x 0.01 =	69.08	(342a)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		261.25	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.15	(357)
SAP value	83.92	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2432.90	x	0.216	=	525.51	(367)
Electrical energy for community heat distribution	23.70	x	0.519	=	12.30	(372)
Total CO2 associated with community systems					537.80	(373)
Total CO2 associated with space and water heating					537.80	(376)
Pumps and fans	76.56	x	0.519	=	39.73	(378)
Electricity for lighting	232.63	x	0.519	=	120.73	(379)
Total CO_2, kg/year				(376)..(382) =	698.27	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.91	(384)
EI value					90.17	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2432.90	x	1.22	=	2968.13	(367)
Electrical energy for community heat distribution	23.70	x	3.07	=	72.75	(372)
Total primary energy associated with community systems					3040.88	(373)
Total primary energy associated with space and water heating					3040.88	(376)
Pumps and fans	76.56	x	3.07	=	235.02	(378)
Electricity for lighting	232.63	x	3.07	=	714.17	(379)
Primary energy kWh/year					3990.07	(383)
Dwelling primary energy rate kWh/m2/year					79.48	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Kf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
Exposed floor			50.20	x	0.10	=	5.02			(28b
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			82.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.17 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		12.41 (36)
Total fabric heat loss	(33) + (36) =	35.58 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.47	46.34	46.21	45.55	45.42	44.76	44.76	44.63	45.02	45.42	45.68	45.95	

Average = ∑(39)1...12/12 = 45.52 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.93	0.92	0.92	0.91	0.90	0.89	0.89	0.89	0.90	0.90	0.91	0.92	

Average = ∑(40)1...12/12 = 0.91 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.95	0.87	0.71	0.53	0.37	0.26	0.30	0.49	0.79	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.43	20.59	20.79	20.95	20.99	21.00	21.00	21.00	21.00	20.92	20.66	20.40	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.15	20.15	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.93	0.85	0.67	0.48	0.32	0.21	0.24	0.44	0.75	0.93	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.42	19.64	19.91	20.11	20.16	20.17	20.17	20.18	20.17	20.08	19.75	19.38	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.90	20.09	20.33	20.51	20.56	20.57	20.57	20.57	20.56	20.48	20.18	19.87	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.90	20.09	20.33	20.51	20.56	20.57	20.57	20.57	20.56	20.48	20.18	19.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.93	0.85	0.69	0.50	0.34	0.24	0.27	0.46	0.77	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	480.48	528.35	551.42	506.67	399.01	266.91	177.63	186.06	289.59	415.79	453.06	460.66	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	725.12	704.12	639.24	528.76	402.20	267.14	177.65	186.10	291.00	448.81	597.64	719.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	182.01	118.12	65.33	15.91	2.37	0.00	0.00	0.00	0.00	24.56	104.09	192.79	

∑(98)1...5, 10...12 = 705.20 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.05 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	705.20		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	148.09	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	592.37	(307b)

Water heating

Annual water heating requirement	1551.60		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.84	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1303.35	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.70	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.56		(330a)
Total electricity for the above, kWh/year		76.56	(331)
Electricity for lighting (Appendix L)		232.63	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2678.82	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	148.09	x	2.97	x 0.01 =	4.40	(340a)
Space heating from boilers	592.37	x	4.24	x 0.01 =	25.12	(340b)
Water heating from CHP	325.84	x	2.97	x 0.01 =	9.68	(342a)
Water heating from boilers	1303.35	x	4.24	x 0.01 =	55.26	(342b)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		255.24	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.29	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	274.0197	x	0.2160	=	59.1883	(363)
less credit emissions for electricity		-90.8537	x	0.5190	=	-47.1531	(364)
Water heated by CHP		602.9087	x	0.2160	=	130.2283	(365)
less credit emissions for electricity		-199.8998	x	0.5190	=	-103.7480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1946.32	x	0.216	=	420.40	(368)
Electrical energy for community heat distribution		23.70	x	0.519	=	12.30	(372)
Total CO2 associated with community systems						471.22	(373)
Total CO2 associated with space and water heating						471.22	(376)
Pumps and fans		76.56	x	0.519	=	39.73	(378)
Electricity for lighting		232.63	x	0.519	=	120.73	(379)
Total CO_2, kg/year					(376)..(382) =	631.68	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.58	(384)
EI value						91.11	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	274.02	x	1.22	=	334.30	(363)
less credit energy for electricity		-90.85	x	3.07	=	-278.92	(364)
Water heated by CHP		602.91	x	1.22	=	735.55	(365)
less credit energy for electricity		-199.90	x	3.07	=	-613.69	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1946.32	x	1.22	=	2374.51	(368)
Electrical energy for community heat distribution		23.70	x	3.07	=	72.75	(372)
Total primary energy associated with community systems						2624.49	(373)
Total primary energy associated with space and water heating						2624.49	(376)
Pumps and fans		76.56	x	3.07	=	235.02	(378)
Electricity for lighting		232.63	x	3.07	=	714.17	(379)
Primary energy kWh/year						3573.68	(383)
Dwelling primary energy rate kWh/m2/year						71.19	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Kf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
Exposed floor			50.20	x	0.10	=	5.02			(28b
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			82.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.17 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		12.41 (36)
Total fabric heat loss	(33) + (36) =	35.58 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

46.47	46.34	46.21	45.55	45.42	44.76	44.76	44.63	45.02	45.42	45.68	45.95	

Average = ∑(39)1...12/12 = 45.52 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.93	0.92	0.92	0.91	0.90	0.89	0.89	0.89	0.90	0.90	0.91	0.92	

Average = ∑(40)1...12/12 = 0.91 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.95	0.87	0.71	0.53	0.37	0.26	0.30	0.49	0.79	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.43	20.59	20.79	20.95	20.99	21.00	21.00	21.00	21.00	20.92	20.66	20.40	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.15	20.15	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.93	0.85	0.67	0.48	0.32	0.21	0.24	0.44	0.75	0.93	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.42	19.64	19.91	20.11	20.16	20.17	20.17	20.18	20.17	20.08	19.75	19.38	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.90	20.09	20.33	20.51	20.56	20.57	20.57	20.57	20.56	20.48	20.18	19.87	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.90	20.09	20.33	20.51	20.56	20.57	20.57	20.57	20.56	20.48	20.18	19.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.93	0.85	0.69	0.50	0.34	0.24	0.27	0.46	0.77	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	480.48	528.35	551.42	506.67	399.01	266.91	177.63	186.06	289.59	415.79	453.06	460.66	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	725.12	704.12	639.24	528.76	402.20	267.14	177.65	186.10	291.00	448.81	597.64	719.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	182.01	118.12	65.33	15.91	2.37	0.00	0.00	0.00	0.00	24.56	104.09	192.79	

∑(98)1...5, 10...12 = 705.20 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.05 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	705.20		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	148.09	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	592.37	(307b)

Water heating

Annual water heating requirement	1551.60		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.84	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1303.35	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.70	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.56		(330a)
Total electricity for the above, kWh/year		76.56	(331)
Electricity for lighting (Appendix L)		232.63	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-222.30	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2456.52	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	148.09	x	2.97	x 0.01 =	4.40	(340a)
Space heating from boilers	592.37	x	4.24	x 0.01 =	25.12	(340b)
Water heating from CHP	325.84	x	2.97	x 0.01 =	9.68	(342a)
Water heating from boilers	1303.35	x	4.24	x 0.01 =	55.26	(342b)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-222.30	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		255.24	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.29	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	274.0197	x	0.2160	=	59.1883	(363)
less credit emissions for electricity		-90.8537	x	0.5190	=	-47.1531	(364)
Water heated by CHP		602.9087	x	0.2160	=	130.2283	(365)
less credit emissions for electricity		-199.8998	x	0.5190	=	-103.7480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1946.32	x	0.216	=	420.40	(368)
Electrical energy for community heat distribution		23.70	x	0.519	=	12.30	(372)
Total CO2 associated with community systems						471.22	(373)
Total CO2 associated with space and water heating						471.22	(376)
Pumps and fans		76.56	x	0.519	=	39.73	(378)
Electricity for lighting		232.63	x	0.519	=	120.73	(379)
Energy saving/generation technologies							

pv savings	-222.30	x	0.519	=	-115.38	(380)
Total CO_2, kg/year				(376)..(382) =	516.31	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.29	(384)
EI value					92.73	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	274.02	x	1.22	=	334.30	(363)
less credit energy for electricity		-90.85	x	3.07	=	-278.92	(364)
Water heated by CHP		602.91	x	1.22	=	735.55	(365)
less credit energy for electricity		-199.90	x	3.07	=	-613.69	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1946.32	x	1.22	=	2374.51	(368)
Electrical energy for community heat distribution		23.70	x	3.07	=	72.75	(372)
Total primary energy associated with community systems						2624.49	(373)
Total primary energy associated with space and water heating						2624.49	(376)
Pumps and fans		76.56	x	3.07	=	235.02	(378)
Electricity for lighting		232.63	x	3.07	=	714.17	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-222.30	x	3.07	=	-682.47	(380)
Primary energy kWh/year						2891.21	(383)
Dwelling primary energy rate kWh/m2/year						57.59	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ko 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			32.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.15 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.88 (36)
Total fabric heat loss	(33) + (36) =	23.03 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

33.92	33.79	33.66	33.00	32.87	32.21	32.21	32.08	32.47	32.87	33.13	33.40	

Average = ∑(39)1...12/12 = 32.97 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.68	0.67	0.67	0.66	0.65	0.64	0.64	0.64	0.65	0.65	0.66	0.67	

Average = ∑(40)1...12/12 = 0.66 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.87	0.73	0.54	0.39	0.26	0.19	0.21	0.36	0.63	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.79	20.89	20.97	21.00	21.00	21.00	21.00	21.00	21.00	20.99	20.92	20.77	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.36	20.36	20.37	20.38	20.38	20.39	20.39	20.40	20.39	20.38	20.38	20.37	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.92	0.85	0.71	0.51	0.36	0.24	0.16	0.18	0.33	0.59	0.84	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.11	20.24	20.34	20.38	20.38	20.39	20.39	20.40	20.39	20.38	20.28	20.08	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.44	20.55	20.64	20.67	20.68	20.68	20.68	20.68	20.68	20.67	20.59	20.41	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.44	20.55	20.64	20.67	20.68	20.68	20.68	20.68	20.68	20.67	20.59	20.41	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.85	0.72	0.53	0.37	0.25	0.18	0.20	0.34	0.61	0.85	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	460.35	484.18	464.01	387.40	294.98	195.92	131.50	137.42	213.66	328.55	412.52	444.78	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	547.36	528.90	475.92	388.50	295.04	195.92	131.50	137.42	213.68	331.00	446.79	541.43	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	64.74	30.05	8.87	0.79	0.05	0.00	0.00	0.00	0.00	1.82	24.67	71.91	

∑(98)1...5, 10...12 = 202.89 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 4.04 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11) — '0' if none = 0.00 (301)

Fraction of space heat from community system — 1 - (301) = 1.00 (302)

Fraction of community heat from boilers = 1.00 (303a)

Fraction of total space heat from community boilers — (302) x (303a) = 1.00 (304a)

Factor for control and charging method (Table 4c(3)) for community space heating = 1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating = 1.00 (305a)

Distribution loss factor (Table 12c) for community heating system = 1.05 (306)

Space heating

Annual space heating requirement: 202.89 (98)

Space heat from boilers — (98) x (304a) x (305) x (306) = 213.03 (307a)

Water heating

Annual water heating requirement: 1551.60 (64)

Water heat from boilers — (64) x (303a) x (305a) x (306) = 1629.18 (310a)

Electricity used for heat distribution — 0.01 × [(307a)...(307e) + (310a)...(310e)] = 18.42 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside: 76.56 (330a)

Total electricity for the above, kWh/year = 76.56 (331)

Electricity for lighting (Appendix L) = 232.63 (332)

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Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2151.40	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	213.03	x	4.24	x 0.01 =	9.03	(340a)
Water heating from boilers	1629.18	x	4.24	x 0.01 =	69.08	(342a)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		238.89	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.30	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1891.39	x	0.216	=	408.54	(367)
Electrical energy for community heat distribution	18.42	x	0.519	=	9.56	(372)
Total CO2 associated with community systems					418.10	(373)
Total CO2 associated with space and water heating					418.10	(376)
Pumps and fans	76.56	x	0.519	=	39.73	(378)
Electricity for lighting	232.63	x	0.519	=	120.73	(379)
Total CO_2, kg/year				(376)..(382) =	578.57	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.53	(384)
EI value					91.86	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1891.39	x	1.22	=	2307.50	(367)
Electrical energy for community heat distribution	18.42	x	3.07	=	56.56	(372)
Total primary energy associated with community systems					2364.06	(373)
Total primary energy associated with space and water heating					2364.06	(376)
Pumps and fans	76.56	x	3.07	=	235.02	(378)
Electricity for lighting	232.63	x	3.07	=	714.17	(379)
Primary energy kWh/year					3313.25	(383)
Dwelling primary energy rate kWh/m2/year					66.00	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ko 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			32.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.15 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.88 (36)
Total fabric heat loss	(33) + (36) =	23.03 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

33.92	33.79	33.66	33.00	32.87	32.21	32.21	32.08	32.47	32.87	33.13	33.40	

Average = ∑(39)1...12/12 = 32.97 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.68	0.67	0.67	0.66	0.65	0.64	0.64	0.64	0.65	0.65	0.66	0.67	

Average = ∑(40)1...12/12 = 0.66 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.87	0.73	0.54	0.39	0.26	0.19	0.21	0.36	0.63	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.79	20.89	20.97	21.00	21.00	21.00	21.00	21.00	21.00	20.99	20.92	20.77	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.36	20.36	20.37	20.38	20.38	20.39	20.39	20.40	20.39	20.38	20.38	20.37	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.92	0.85	0.71	0.51	0.36	0.24	0.16	0.18	0.33	0.59	0.84	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.11	20.24	20.34	20.38	20.38	20.39	20.39	20.40	20.39	20.38	20.28	20.08	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.44	20.55	20.64	20.67	20.68	20.68	20.68	20.68	20.68	20.67	20.59	20.41	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.44	20.55	20.64	20.67	20.68	20.68	20.68	20.68	20.68	20.67	20.59	20.41	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.85	0.72	0.53	0.37	0.25	0.18	0.20	0.34	0.61	0.85	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	460.35	484.18	464.01	387.40	294.98	195.92	131.50	137.42	213.66	328.55	412.52	444.78	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	547.36	528.90	475.92	388.50	295.04	195.92	131.50	137.42	213.68	331.00	446.79	541.43	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	64.74	30.05	8.87	0.79	0.05	0.00	0.00	0.00	0.00	1.82	24.67	71.91	

∑(98)1...5, 10...12 = 202.89 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 4.04 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	202.89		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	42.61	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	170.43	(307b)

Water heating

Annual water heating requirement	1551.60		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.84	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1303.35	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	18.42	(313)

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Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.56		(330a)
Total electricity for the above, kWh/year		76.56	(331)
Electricity for lighting (Appendix L)		232.63	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2151.40	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	42.61	x	2.97	x 0.01 =	1.27	(340a)
Space heating from boilers	170.43	x	4.24	x 0.01 =	7.23	(340b)
Water heating from CHP	325.84	x	2.97	x 0.01 =	9.68	(342a)
Water heating from boilers	1303.35	x	4.24	x 0.01 =	55.26	(342b)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		234.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.59	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	78.8374	x	0.2160	=	17.0289	(363)
less credit emissions for electricity		-26.1393	x	0.5190	=	-13.5663	(364)
Water heated by CHP		602.9087	x	0.2160	=	130.2283	(365)
less credit emissions for electricity		-199.8998	x	0.5190	=	-103.7480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1513.12	x	0.216	=	326.83	(368)
Electrical energy for community heat distribution		18.42	x	0.519	=	9.56	(372)
Total CO2 associated with community systems						366.34	(373)
Total CO2 associated with space and water heating						366.34	(376)
Pumps and fans		76.56	x	0.519	=	39.73	(378)
Electricity for lighting		232.63	x	0.519	=	120.73	(379)
Total CO_2, kg/year					(376)..(382) =	526.80	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.49	(384)
EI value						92.58	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	78.84	x	1.22	=	96.18	(363)
less credit energy for electricity		-26.14	x	3.07	=	-80.25	(364)
Water heated by CHP		602.91	x	1.22	=	735.55	(365)
less credit energy for electricity		-199.90	x	3.07	=	-613.69	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1513.12	x	1.22	=	1846.00	(368)
Electrical energy for community heat distribution		18.42	x	3.07	=	56.56	(372)
Total primary energy associated with community systems						2040.35	(373)
Total primary energy associated with space and water heating						2040.35	(376)
Pumps and fans		76.56	x	3.07	=	235.02	(378)
Electricity for lighting		232.63	x	3.07	=	714.17	(379)
Primary energy kWh/year						2989.54	(383)
Dwelling primary energy rate kWh/m2/year						59.55	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ko 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			32.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.15 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.88 (36)
Total fabric heat loss	(33) + (36) =	23.03 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

33.92	33.79	33.66	33.00	32.87	32.21	32.21	32.08	32.47	32.87	33.13	33.40	

Average = ∑(39)1...12/12 = 32.97 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.68	0.67	0.67	0.66	0.65	0.64	0.64	0.64	0.65	0.65	0.66	0.67	

Average = ∑(40)1...12/12 = 0.66 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.87	0.73	0.54	0.39	0.26	0.19	0.21	0.36	0.63	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.79	20.89	20.97	21.00	21.00	21.00	21.00	21.00	21.00	20.99	20.92	20.77	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.36	20.36	20.37	20.38	20.38	20.39	20.39	20.40	20.39	20.38	20.38	20.37	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.92	0.85	0.71	0.51	0.36	0.24	0.16	0.18	0.33	0.59	0.84	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.11	20.24	20.34	20.38	20.38	20.39	20.39	20.40	20.39	20.38	20.28	20.08	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.44	20.55	20.64	20.67	20.68	20.68	20.68	20.68	20.68	20.67	20.59	20.41	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.44	20.55	20.64	20.67	20.68	20.68	20.68	20.68	20.68	20.67	20.59	20.41	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.85	0.72	0.53	0.37	0.25	0.18	0.20	0.34	0.61	0.85	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	460.35	484.18	464.01	387.40	294.98	195.92	131.50	137.42	213.66	328.55	412.52	444.78	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	547.36	528.90	475.92	388.50	295.04	195.92	131.50	137.42	213.68	331.00	446.79	541.43	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	64.74	30.05	8.87	0.79	0.05	0.00	0.00	0.00	0.00	1.82	24.67	71.91	

∑(98)1...5, 10...12 = 202.89 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 4.04 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	202.89		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	42.61	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	170.43	(307b)

Water heating

Annual water heating requirement	1551.60		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.84	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1303.35	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	18.42	(313)

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Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.56		(330a)
Total electricity for the above, kWh/year		76.56	(331)
Electricity for lighting (Appendix L)		232.63	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	1918.22	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	42.61	x	2.97	x 0.01 =	1.27	(340a)
Space heating from boilers	170.43	x	4.24	x 0.01 =	7.23	(340b)
Water heating from CHP	325.84	x	2.97	x 0.01 =	9.68	(342a)
Water heating from boilers	1303.35	x	4.24	x 0.01 =	55.26	(342b)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		234.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.59	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	78.8374	x	0.2160	=	17.0289	(363)
less credit emissions for electricity		-26.1393	x	0.5190	=	-13.5663	(364)
Water heated by CHP		602.9087	x	0.2160	=	130.2283	(365)
less credit emissions for electricity		-199.8998	x	0.5190	=	-103.7480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1513.12	x	0.216	=	326.83	(368)
Electrical energy for community heat distribution		18.42	x	0.519	=	9.56	(372)
Total CO2 associated with community systems						366.34	(373)
Total CO2 associated with space and water heating						366.34	(376)
Pumps and fans		76.56	x	0.519	=	39.73	(378)
Electricity for lighting		232.63	x	0.519	=	120.73	(379)
Energy saving/generation technologies							
pv savings		-233.18	x	0.519	=	-121.02	(380)

Total CO_2, kg/year	(376)..(382) =	405.78	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	8.08	(384)
EI value		94.29	
EI rating (section 14)		94	(385)
EI band		A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	78.84	x	1.22	=	96.18	(363)
less credit energy for electricity		-26.14	x	3.07	=	-80.25	(364)
Water heated by CHP		602.91	x	1.22	=	735.55	(365)
less credit energy for electricity		-199.90	x	3.07	=	-613.69	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1513.12	x	1.22	=	1846.00	(368)
Electrical energy for community heat distribution		18.42	x	3.07	=	56.56	(372)
Total primary energy associated with community systems						2040.35	(373)
Total primary energy associated with space and water heating						2040.35	(376)
Pumps and fans		76.56	x	3.07	=	235.02	(378)
Electricity for lighting		232.63	x	3.07	=	714.17	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2273.68	(383)
Dwelling primary energy rate kWh/m2/year						45.29	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Kr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Roof			50.20	x	0.12	=	6.02			(30)
Total area of external elements ∑A, m²			82.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.18 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		12.41 (36)
Total fabric heat loss	(33) + (36) =	36.58 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

47.48	47.35	47.21	46.55	46.42	45.76	45.76	45.63	46.03	46.42	46.69	46.95	

Average = ∑(39)1...12/12 = 46.52 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.95	0.94	0.94	0.93	0.92	0.91	0.91	0.91	0.92	0.92	0.93	0.94	

Average = ∑(40)1...12/12 = 0.93 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.95	0.88	0.72	0.54	0.38	0.27	0.30	0.50	0.80	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.40	20.56	20.77	20.94	20.99	21.00	21.00	21.00	20.99	20.91	20.64	20.37	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.13	20.13	20.13	20.14	20.15	20.16	20.16	20.16	20.15	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.85	0.68	0.49	0.33	0.22	0.25	0.44	0.76	0.93	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.36	19.59	19.87	20.08	20.14	20.16	20.16	20.16	20.15	20.06	19.70	19.32	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.86	20.05	20.30	20.49	20.55	20.56	20.56	20.56	20.55	20.46	20.15	19.82	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.86	20.05	20.30	20.49	20.55	20.56	20.56	20.56	20.55	20.46	20.15	19.82	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.70	0.51	0.35	0.24	0.27	0.47	0.78	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	481.12	529.92	555.36	514.07	406.71	272.42	181.20	189.83	295.31	420.54	454.50	461.14	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	738.75	717.50	651.69	539.61	410.61	272.72	181.23	189.88	297.04	457.83	609.14	733.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	191.68	126.05	71.67	18.39	2.90	0.00	0.00	0.00	0.00	27.75	111.34	202.62	

∑(98)1...5, 10...12 = 752.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.99 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	752.40		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	790.02	(307a)

Water heating

Annual water heating requirement	1551.60		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1629.18	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.19	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	76.56		(330a)
Total electricity for the above, kWh/year		76.56	(331)

Electricity for lighting (Appendix L)		232.63	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2728.38	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	790.02	x	4.24	x 0.01 =	33.50	(340a)
Water heating from boilers	1629.18	x	4.24	x 0.01 =	69.08	(342a)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		263.36	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.16	(357)
SAP value	83.79	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2483.78	x	0.216	=	536.50	(367)
Electrical energy for community heat distribution	24.19	x	0.519	=	12.56	(372)
Total CO2 associated with community systems					549.05	(373)
Total CO2 associated with space and water heating					549.05	(376)
Pumps and fans	76.56	x	0.519	=	39.73	(378)
Electricity for lighting	232.63	x	0.519	=	120.73	(379)
Total CO_2, kg/year				(376)..(382) =	709.52	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	14.13	(384)
EI value					90.01	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2483.78	x	1.22	=	3030.21	(367)
Electrical energy for community heat distribution	24.19	x	3.07	=	74.27	(372)
Total primary energy associated with community systems					3104.48	(373)
Total primary energy associated with space and water heating					3104.48	(376)
Pumps and fans	76.56	x	3.07	=	235.02	(378)
Electricity for lighting	232.63	x	3.07	=	714.17	(379)
Primary energy kWh/year					4053.67	(383)
Dwelling primary energy rate kWh/m2/year					80.75	(384)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Kr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Roof			50.20	x	0.12	=	6.02			(30)
Total area of external elements ∑A, m²			82.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.18 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		12.41 (36)
Total fabric heat loss	(33) + (36) =	36.58 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

47.48	47.35	47.21	46.55	46.42	45.76	45.76	45.63	46.03	46.42	46.69	46.95	

Average = ∑(39)1...12/12 = 46.52 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.95	0.94	0.94	0.93	0.92	0.91	0.91	0.91	0.92	0.92	0.93	0.94	

Average = ∑(40)1...12/12 = 0.93 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N: 1.70 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel: 1.00 (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.29 (48)

Temperature factor from Table 2b: 1.00 (49)

Energy lost from water storage (kWh/day) (48) x (49): 0.29 (50)

Enter (50) or (54) in (55): 0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.95	0.88	0.72	0.54	0.38	0.27	0.30	0.50	0.80	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.40	20.56	20.77	20.94	20.99	21.00	21.00	21.00	20.99	20.91	20.64	20.37	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.13	20.13	20.13	20.14	20.15	20.16	20.16	20.16	20.15	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.85	0.68	0.49	0.33	0.22	0.25	0.44	0.76	0.93	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.36	19.59	19.87	20.08	20.14	20.16	20.16	20.16	20.15	20.06	19.70	19.32	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.86	20.05	20.30	20.49	20.55	20.56	20.56	20.56	20.55	20.46	20.15	19.82	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.86	20.05	20.30	20.49	20.55	20.56	20.56	20.56	20.55	20.46	20.15	19.82	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.70	0.51	0.35	0.24	0.27	0.47	0.78	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	481.12	529.92	555.36	514.07	406.71	272.42	181.20	189.83	295.31	420.54	454.50	461.14	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	738.75	717.50	651.69	539.61	410.61	272.72	181.23	189.88	297.04	457.83	609.14	733.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	191.68	126.05	71.67	18.39	2.90	0.00	0.00	0.00	0.00	27.75	111.34	202.62	

∑(98)1...5, 10...12 = 752.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.99 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	752.40		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	158.00	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	632.01	(307b)

Water heating

Annual water heating requirement	1551.60		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.84	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1303.35	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.19	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.56		(330a)
Total electricity for the above, kWh/year		76.56	(331)
Electricity for lighting (Appendix L)		232.63	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-259.09	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2469.30	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	158.00	x	2.97	x 0.01 =	4.69	(340a)
Space heating from boilers	632.01	x	4.24	x 0.01 =	26.80	(340b)
Water heating from CHP	325.84	x	2.97	x 0.01 =	9.68	(342a)
Water heating from boilers	1303.35	x	4.24	x 0.01 =	55.26	(342b)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		257.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.17	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	292.3604	x	0.2160	=	63.1499	(363)
less credit emissions for electricity		-96.9347	x	0.5190	=	-50.3091	(364)
Water heated by CHP		602.9087	x	0.2160	=	130.2283	(365)
less credit emissions for electricity		-199.8998	x	0.5190	=	-103.7480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1987.02	x	0.216	=	429.20	(368)
Electrical energy for community heat distribution		24.19	x	0.519	=	12.56	(372)
Total CO2 associated with community systems						481.07	(373)
Total CO2 associated with space and water heating						481.07	(376)
Pumps and fans		76.56	x	0.519	=	39.73	(378)
Electricity for lighting		232.63	x	0.519	=	120.73	(379)
Energy saving/generation technologies							

pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO_2, kg/year				(376)..(382) =	507.07	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.10	(384)
EI value					92.86	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	292.36	x	1.22	=	356.68	(363)
less credit energy for electricity		-96.93	x	3.07	=	-297.59	(364)
Water heated by CHP		602.91	x	1.22	=	735.55	(365)
less credit energy for electricity		-199.90	x	3.07	=	-613.69	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1987.02	x	1.22	=	2424.17	(368)
Electrical energy for community heat distribution		24.19	x	3.07	=	74.27	(372)
Total primary energy associated with community systems						2679.38	(373)
Total primary energy associated with space and water heating						2679.38	(376)
Pumps and fans		76.56	x	3.07	=	235.02	(378)
Electricity for lighting		232.63	x	3.07	=	714.17	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year						2833.18	(383)
Dwelling primary energy rate kWh/m2/year						56.44	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Kr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.20	(1a) x	2.50	(2a) =	125.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.23	x	1.24	=	15.11			(27)
External wall			20.27	x	0.15	=	3.04			(29a)
Party wall			52.50	x	0.00	=	0.00			(32)
Roof			50.20	x	0.12	=	6.02			(30)
Total area of external elements ∑A, m²			82.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.18 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		12.41 (36)
Total fabric heat loss	(33) + (36) =	36.58 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
10.89	10.76	10.63	9.97	9.84	9.18	9.18	9.05	9.44	9.84	10.10	10.37	(38)

Heat transfer coefficient, W/K (37)m + (38)m

47.48	47.35	47.21	46.55	46.42	45.76	45.76	45.63	46.03	46.42	46.69	46.95	

Average = ∑(39)1...12/12 = 46.52 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.95	0.94	0.94	0.93	0.92	0.91	0.91	0.91	0.92	0.92	0.93	0.94	

Average = ∑(40)1...12/12 = 0.93 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.48 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93	

∑(44)1...12 = 893.76 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

121.50	106.26	109.65	95.60	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66	

∑(45)1...12 = 1171.86 (45)

Distribution loss 0.15 x (45)m

18.22	15.94	16.45	14.34	13.76	11.87	11.00	12.63	12.78	14.89	16.25	17.65	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

153.75	135.39	141.90	126.81	123.98	110.37	105.60	116.42	116.39	131.51	139.56	149.92	

∑(64)1...12 = 1551.60 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

66.20	58.64	62.26	56.76	56.30	51.29	50.19	53.79	53.29	58.81	61.00	64.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	101.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	32.93	29.25	23.79	18.01	13.46	11.36	12.28	15.96	21.42	27.20	31.75	33.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	220.53	222.82	217.05	204.77	189.28	174.71	164.98	162.69	168.46	180.74	196.23	210.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	46.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
Water heating gains (Table 5)	88.98	87.26	83.68	78.83	75.67	71.23	67.46	72.30	74.01	79.04	84.72	87.26	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	423.23	420.11	405.31	382.40	359.20	338.10	325.51	331.74	344.69	367.77	393.49	412.70	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	12.23	x	19.64	x 0.9 x	0.50	x	0.90	=	74.91	(76)

Solar gains in watts ∑(74)m...(82)m

74.91	146.53	241.32	351.95	431.33	441.54	420.36	361.09	280.66	173.87	93.40	61.60	(83)

Total gains - internal and solar (73)m + (83)m

498.13	566.65	646.63	734.35	790.53	779.64	745.88	692.83	625.35	541.64	486.89	474.30	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.95	0.88	0.72	0.54	0.38	0.27	0.30	0.50	0.80	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.40	20.56	20.77	20.94	20.99	21.00	21.00	21.00	20.99	20.91	20.64	20.37	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.13	20.13	20.13	20.14	20.15	20.16	20.16	20.16	20.15	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.85	0.68	0.49	0.33	0.22	0.25	0.44	0.76	0.93	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.36	19.59	19.87	20.08	20.14	20.16	20.16	20.16	20.15	20.06	19.70	19.32	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.86	20.05	20.30	20.49	20.55	20.56	20.56	20.56	20.55	20.46	20.15	19.82	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.86	20.05	20.30	20.49	20.55	20.56	20.56	20.56	20.55	20.46	20.15	19.82	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.70	0.51	0.35	0.24	0.27	0.47	0.78	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	481.12	529.92	555.36	514.07	406.71	272.42	181.20	189.83	295.31	420.54	454.50	461.14	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	738.75	717.50	651.69	539.61	410.61	272.72	181.23	189.88	297.04	457.83	609.14	733.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	191.68	126.05	71.67	18.39	2.90	0.00	0.00	0.00	0.00	27.75	111.34	202.62	

∑(98)1...5, 10...12 = 752.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 14.99 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	752.40		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	158.00	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	632.01	(307b)

Water heating

Annual water heating requirement	1551.60		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	325.84	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1303.35	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.19	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	76.56		(330a)
Total electricity for the above, kWh/year		76.56	(331)
Electricity for lighting (Appendix L)		232.63	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2495.21	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	158.00	x	2.97	x 0.01 =	4.69	(340a)
Space heating from boilers	632.01	x	4.24	x 0.01 =	26.80	(340b)
Water heating from CHP	325.84	x	2.97	x 0.01 =	9.68	(342a)
Water heating from boilers	1303.35	x	4.24	x 0.01 =	55.26	(342b)
Pumps and fans	76.56	x	13.19	x 0.01 =	10.10	(349)
Electricity for lighting	232.63	x	13.19	x 0.01 =	30.68	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		257.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.17	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	292.3604	x	0.2160	=	63.1499	(363)
less credit emissions for electricity		-96.9347	x	0.5190	=	-50.3091	(364)
Water heated by CHP		602.9087	x	0.2160	=	130.2283	(365)
less credit emissions for electricity		-199.8998	x	0.5190	=	-103.7480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1987.02	x	0.216	=	429.20	(368)
Electrical energy for community heat distribution		24.19	x	0.519	=	12.56	(372)
Total CO2 associated with community systems						481.07	(373)
Total CO2 associated with space and water heating						481.07	(376)
Pumps and fans		76.56	x	0.519	=	39.73	(378)
Electricity for lighting		232.63	x	0.519	=	120.73	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	520.52	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.37	(384)
EI value					92.67	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	292.36	x	1.22	=	356.68	(363)
less credit energy for electricity		-96.93	x	3.07	=	-297.59	(364)
Water heated by CHP		602.91	x	1.22	=	735.55	(365)
less credit energy for electricity		-199.90	x	3.07	=	-613.69	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1987.02	x	1.22	=	2424.17	(368)
Electrical energy for community heat distribution		24.19	x	3.07	=	74.27	(372)
Total primary energy associated with community systems						2679.38	(373)
Total primary energy associated with space and water heating						2679.38	(376)
Pumps and fans		76.56	x	3.07	=	235.02	(378)
Electricity for lighting		232.63	x	3.07	=	714.17	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2912.72	(383)
Dwelling primary energy rate kWh/m2/year						58.02	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Lf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.90	(1a) x	2.50	(2a) =	177.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.06	x	1.24	=	19.85			(27)
Exposed floor			70.90	x	0.10	=	7.09			(28b
External wall			14.69	x	0.15	=	2.20			(29a)
Party wall			58.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			101.65							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.14 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.25 (36)
Total fabric heat loss	(33) + (36) =	44.39 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.39	15.20	15.01	14.08	13.90	12.96	12.96	12.78	13.34	13.90	14.27	14.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

59.77	59.59	59.40	58.47	58.28	57.35	57.35	57.16	57.72	58.28	58.66	59.03	

Average = ∑(39)1...12/12 = 58.42 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.81	0.81	0.82	0.83	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.87	93.34	89.82	86.30	82.78	79.25	79.25	82.78	86.30	89.82	93.34	96.87	

∑(44)1...12 = 1056.72 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.65	125.64	129.65	113.03	108.45	93.59	86.72	99.51	100.70	117.36	128.11	139.12	

∑(45)1...12 = 1385.52 (45)

Distribution loss 0.15 x (45)m

21.55	18.85	19.45	16.95	16.27	14.04	13.01	14.93	15.11	17.60	19.22	20.87	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	

∑(64)1...12 = 1765.27 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.57	65.08	68.91	62.55	61.86	56.09	54.64	58.89	58.45	64.82	67.57	72.06	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.44	39.47	32.10	24.30	18.17	15.34	16.57	21.54	28.91	36.71	42.84	45.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.59	300.68	292.90	276.33	255.42	235.77	222.64	219.55	227.33	243.90	264.81	284.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	(71)
Water heating gains (Table 5)	98.88	96.84	92.62	86.88	83.15	77.90	73.44	79.15	81.19	87.13	93.84	96.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.14	533.23	513.85	483.74	452.97	425.23	408.87	416.47	433.66	463.96	497.72	523.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	16.06	x	19.64	x 0.9 x	0.50	x	0.90	=	98.36	(80)

Solar gains in watts ∑(74)m...(82)m

98.36	192.42	316.89	462.17	566.40	579.81	552.01	474.17	368.56	228.32	122.65	80.89	(83)

Total gains - internal and solar (73)m + (83)m

635.51	725.65	830.74	945.91	1019.37	1005.05	960.88	890.64	802.21	692.29	620.37	604.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.88	0.72	0.53	0.36	0.26	0.30	0.49	0.80	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.47	20.63	20.82	20.96	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.44	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.22	20.22	20.22	20.23	20.23	20.25	20.25	20.25	20.24	20.23	20.23	20.23 (88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.86	0.68	0.49	0.32	0.22	0.25	0.44	0.76	0.94	0.98 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.53	19.75	20.01	20.19	20.23	20.25	20.25	20.25	20.24	20.17	19.85	19.50 (90)

Living area fraction — Living area ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.84	20.03	20.27	20.44	20.48	20.49	20.49	20.49	20.48	20.41	20.12	19.80 (92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.84	20.03	20.27	20.44	20.48	20.49	20.49	20.49	20.48	20.41	20.12	19.80 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.69	0.50	0.34	0.23	0.26	0.46	0.77	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	617.35	682.79	714.73	652.19	508.83	337.53	222.98	233.76	367.36	535.36	583.10	590.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	928.65	901.66	818.04	674.58	511.47	337.68	222.99	233.78	368.45	571.86	763.51	920.89	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	231.61	147.08	76.86	16.12	1.97	0.00	0.00	0.00	0.00	27.15	129.90	245.83	

∑(98)1...5, 10...12 = 876.52 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.36 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		1.00 (303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	876.52		(98)
Space heat from boilers		(98) x (304a) x (305) x (306) = 920.35	(307a)

Water heating

Annual water heating requirement	1765.27		(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) = 1853.53	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] = 27.74	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	116.23		(330a)
Total electricity for the above, kWh/year		116.23	(331)

Electricity for lighting (Appendix L)		313.92	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3204.03	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	920.35	x	4.24	x 0.01 =	39.02	(340a)
Water heating from boilers	1853.53	x	4.24	x 0.01 =	78.59	(342a)
Pumps and fans	116.23	x	13.19	x 0.01 =	15.33	(349)
Electricity for lighting	313.92	x	13.19	x 0.01 =	41.41	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		294.35	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.12	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2847.92	x	0.216	=	615.15	(367)
Electrical energy for community heat distribution	27.74	x	0.519	=	14.40	(372)
Total CO2 associated with community systems					629.55	(373)
Total CO2 associated with space and water heating					629.55	(376)
Pumps and fans	116.23	x	0.519	=	60.32	(378)
Electricity for lighting	313.92	x	0.519	=	162.93	(379)
Total CO_2, kg/year				(376)..(382) =	852.80	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.03	(384)
EI value					90.14	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2847.92	x	1.22	=	3474.47	(367)
Electrical energy for community heat distribution	27.74	x	3.07	=	85.16	(372)
Total primary energy associated with community systems					3559.62	(373)
Total primary energy associated with space and water heating					3559.62	(376)
Pumps and fans	116.23	x	3.07	=	356.83	(378)
Electricity for lighting	313.92	x	3.07	=	963.74	(379)
Primary energy kWh/year					4880.20	(383)
Dwelling primary energy rate kWh/m2/year					68.83	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Lf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.90	(1a) x	2.50	(2a) =	177.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.06	x	1.24	=	19.85			(27)
Exposed floor			70.90	x	0.10	=	7.09			(28b
External wall			14.69	x	0.15	=	2.20			(29a)
Party wall			58.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			101.65							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.14 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.25 (36)
Total fabric heat loss	(33) + (36) =	44.39 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.39	15.20	15.01	14.08	13.90	12.96	12.96	12.78	13.34	13.90	14.27	14.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

59.77	59.59	59.40	58.47	58.28	57.35	57.35	57.16	57.72	58.28	58.66	59.03	

Average = ∑(39)1...12/12 = 58.42 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.81	0.81	0.82	0.83	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.87	93.34	89.82	86.30	82.78	79.25	79.25	82.78	86.30	89.82	93.34	96.87	

∑(44)1...12 = 1056.72 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.65	125.64	129.65	113.03	108.45	93.59	86.72	99.51	100.70	117.36	128.11	139.12	

∑(45)1...12 = 1385.52 (45)

Distribution loss 0.15 x (45)m

21.55	18.85	19.45	16.95	16.27	14.04	13.01	14.93	15.11	17.60	19.22	20.87	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	

∑(64)1...12 = 1765.27 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.57	65.08	68.91	62.55	61.86	56.09	54.64	58.89	58.45	64.82	67.57	72.06	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.44	39.47	32.10	24.30	18.17	15.34	16.57	21.54	28.91	36.71	42.84	45.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.59	300.68	292.90	276.33	255.42	235.77	222.64	219.55	227.33	243.90	264.81	284.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	(71)
Water heating gains (Table 5)	98.88	96.84	92.62	86.88	83.15	77.90	73.44	79.15	81.19	87.13	93.84	96.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.14	533.23	513.85	483.74	452.97	425.23	408.87	416.47	433.66	463.96	497.72	523.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	16.06	x	19.64	x 0.9 x	0.50	x	0.90	=	98.36	(80)

Solar gains in watts ∑(74)m...(82)m

98.36	192.42	316.89	462.17	566.40	579.81	552.01	474.17	368.56	228.32	122.65	80.89	(83)

Total gains - internal and solar (73)m + (83)m

635.51	725.65	830.74	945.91	1019.37	1005.05	960.88	890.64	802.21	692.29	620.37	604.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.88	0.72	0.53	0.36	0.26	0.30	0.49	0.80	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.47	20.63	20.82	20.96	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.44	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.22	20.22	20.22	20.23	20.23	20.25	20.25	20.25	20.24	20.23	20.23	20.23 (88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.86	0.68	0.49	0.32	0.22	0.25	0.44	0.76	0.94	0.98 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.53	19.75	20.01	20.19	20.23	20.25	20.25	20.25	20.24	20.17	19.85	19.50 (90)

Living area fraction — Living area ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.84	20.03	20.27	20.44	20.48	20.49	20.49	20.49	20.48	20.41	20.12	19.80 (92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.84	20.03	20.27	20.44	20.48	20.49	20.49	20.49	20.48	20.41	20.12	19.80 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.69	0.50	0.34	0.23	0.26	0.46	0.77	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	617.35	682.79	714.73	652.19	508.83	337.53	222.98	233.76	367.36	535.36	583.10	590.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	928.65	901.66	818.04	674.58	511.47	337.68	222.99	233.78	368.45	571.86	763.51	920.89	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	231.61	147.08	76.86	16.12	1.97	0.00	0.00	0.00	0.00	27.15	129.90	245.83	

∑(98)1...5, 10...12 = 876.52 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.36 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	876.52		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	184.07	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	736.28	(307b)

Water heating

Annual water heating requirement	1765.27		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.71	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.82	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.74	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.23		(330a)
Total electricity for the above, kWh/year		116.23	(331)
Electricity for lighting (Appendix L)		313.92	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3204.03	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	184.07	x	2.97	x 0.01 =	5.47	(340a)
Space heating from boilers	736.28	x	4.24	x 0.01 =	31.22	(340b)
Water heating from CHP	370.71	x	2.97	x 0.01 =	11.01	(342a)
Water heating from boilers	1482.82	x	4.24	x 0.01 =	62.87	(342b)
Pumps and fans	116.23	x	13.19	x 0.01 =	15.33	(349)
Electricity for lighting	313.92	x	13.19	x 0.01 =	41.41	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		287.30	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.48	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	340.5906	x	0.2160	=	73.5676	(363)
less credit emissions for electricity		-112.9259	x	0.5190	=	-58.6085	(364)
Water heated by CHP		685.9326	x	0.2160	=	148.1614	(365)
less credit emissions for electricity		-227.4271	x	0.5190	=	-118.0347	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2278.34	x	0.216	=	492.12	(368)
Electrical energy for community heat distribution		27.74	x	0.519	=	14.40	(372)
Total CO2 associated with community systems						551.60	(373)
Total CO2 associated with space and water heating						551.60	(376)
Pumps and fans		116.23	x	0.519	=	60.32	(378)
Electricity for lighting		313.92	x	0.519	=	162.93	(379)
Total CO_2, kg/year					(376)..(382) =	774.85	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.93	(384)
EI value						91.04	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	340.59	x	1.22	=	415.52	(363)
less credit energy for electricity		-112.93	x	3.07	=	-346.68	(364)
Water heated by CHP		685.93	x	1.22	=	836.84	(365)
less credit energy for electricity		-227.43	x	3.07	=	-698.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2278.34	x	1.22	=	2779.57	(368)
Electrical energy for community heat distribution		27.74	x	3.07	=	85.16	(372)
Total primary energy associated with community systems						3072.21	(373)
Total primary energy associated with space and water heating						3072.21	(376)
Pumps and fans		116.23	x	3.07	=	356.83	(378)
Electricity for lighting		313.92	x	3.07	=	963.74	(379)
Primary energy kWh/year						4392.78	(383)
Dwelling primary energy rate kWh/m2/year						61.96	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Lf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.90	(1a) x	2.50	(2a) =	177.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.06	x	1.24	=	19.85			(27)
Exposed floor			70.90	x	0.10	=	7.09			(28b
External wall			14.69	x	0.15	=	2.20			(29a)
Party wall			58.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			101.65							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.14 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.25 (36)
Total fabric heat loss	(33) + (36) =	44.39 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.39	15.20	15.01	14.08	13.90	12.96	12.96	12.78	13.34	13.90	14.27	14.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

59.77	59.59	59.40	58.47	58.28	57.35	57.35	57.16	57.72	58.28	58.66	59.03	

Average = ∑(39)1...12/12 = 58.42 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.81	0.81	0.82	0.83	0.83	

Average = ∑(40)1...12/12 = 0.82 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.87	93.34	89.82	86.30	82.78	79.25	79.25	82.78	86.30	89.82	93.34	96.87	

∑(44)1...12 = 1056.72 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.65	125.64	129.65	113.03	108.45	93.59	86.72	99.51	100.70	117.36	128.11	139.12	

∑(45)1...12 = 1385.52 (45)

Distribution loss 0.15 x (45)m

21.55	18.85	19.45	16.95	16.27	14.04	13.01	14.93	15.11	17.60	19.22	20.87	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	

∑(64)1...12 = 1765.27 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.57	65.08	68.91	62.55	61.86	56.09	54.64	58.89	58.45	64.82	67.57	72.06	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.44	39.47	32.10	24.30	18.17	15.34	16.57	21.54	28.91	36.71	42.84	45.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.59	300.68	292.90	276.33	255.42	235.77	222.64	219.55	227.33	243.90	264.81	284.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	(71)
Water heating gains (Table 5)	98.88	96.84	92.62	86.88	83.15	77.90	73.44	79.15	81.19	87.13	93.84	96.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.14	533.23	513.85	483.74	452.97	425.23	408.87	416.47	433.66	463.96	497.72	523.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	16.06	x	19.64	x 0.9 x	0.50	x	0.90	=	98.36	(80)

Solar gains in watts ∑(74)m...(82)m

98.36	192.42	316.89	462.17	566.40	579.81	552.01	474.17	368.56	228.32	122.65	80.89	(83)

Total gains - internal and solar (73)m + (83)m

635.51	725.65	830.74	945.91	1019.37	1005.05	960.88	890.64	802.21	692.29	620.37	604.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.88	0.72	0.53	0.36	0.26	0.30	0.49	0.80	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.47	20.63	20.82	20.96	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.44	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.22	20.22	20.22	20.23	20.23	20.25	20.25	20.25	20.24	20.23	20.23	20.23 (88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.86	0.68	0.49	0.32	0.22	0.25	0.44	0.76	0.94	0.98 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.53	19.75	20.01	20.19	20.23	20.25	20.25	20.25	20.24	20.17	19.85	19.50 (90)

Living area fraction — Living area ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.84	20.03	20.27	20.44	20.48	20.49	20.49	20.49	20.48	20.41	20.12	19.80 (92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.84	20.03	20.27	20.44	20.48	20.49	20.49	20.49	20.48	20.41	20.12	19.80 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.69	0.50	0.34	0.23	0.26	0.46	0.77	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	617.35	682.79	714.73	652.19	508.83	337.53	222.98	233.76	367.36	535.36	583.10	590.47	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	928.65	901.66	818.04	674.58	511.47	337.68	222.99	233.78	368.45	571.86	763.51	920.89	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	231.61	147.08	76.86	16.12	1.97	0.00	0.00	0.00	0.00	27.15	129.90	245.83	

∑(98)1...5, 10...12 = 876.52 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.36 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	876.52		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	184.07	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	736.28	(307b)

Water heating

Annual water heating requirement	1765.27		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.71	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.82	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	27.74	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.23		(330a)
Total electricity for the above, kWh/year		116.23	(331)
Electricity for lighting (Appendix L)		313.92	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2970.85	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	184.07	x	2.97	x 0.01 =	5.47	(340a)
Space heating from boilers	736.28	x	4.24	x 0.01 =	31.22	(340b)
Water heating from CHP	370.71	x	2.97	x 0.01 =	11.01	(342a)
Water heating from boilers	1482.82	x	4.24	x 0.01 =	62.87	(342b)
Pumps and fans	116.23	x	13.19	x 0.01 =	15.33	(349)
Electricity for lighting	313.92	x	13.19	x 0.01 =	41.41	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		287.30	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.48	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	340.5906	x	0.2160	=	73.5676	(363)
less credit emissions for electricity		-112.9259	x	0.5190	=	-58.6085	(364)
Water heated by CHP		685.9326	x	0.2160	=	148.1614	(365)
less credit emissions for electricity		-227.4271	x	0.5190	=	-118.0347	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2278.34	x	0.216	=	492.12	(368)
Electrical energy for community heat distribution		27.74	x	0.519	=	14.40	(372)
Total CO2 associated with community systems						551.60	(373)
Total CO2 associated with space and water heating						551.60	(376)
Pumps and fans		116.23	x	0.519	=	60.32	(378)
Electricity for lighting		313.92	x	0.519	=	162.93	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	653.83	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.22	(384)
EI value					92.44	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	340.59	x	1.22	=	415.52	(363)
less credit energy for electricity		-112.93	x	3.07	=	-346.68	(364)
Water heated by CHP		685.93	x	1.22	=	836.84	(365)
less credit energy for electricity		-227.43	x	3.07	=	-698.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2278.34	x	1.22	=	2779.57	(368)
Electrical energy for community heat distribution		27.74	x	3.07	=	85.16	(372)
Total primary energy associated with community systems						3072.21	(373)
Total primary energy associated with space and water heating						3072.21	(376)
Pumps and fans		116.23	x	3.07	=	356.83	(378)
Electricity for lighting		313.92	x	3.07	=	963.74	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3676.93	(383)
Dwelling primary energy rate kWh/m2/year						51.86	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Lo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.90	(1a) x	2.50	(2a) =	177.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.06	x	1.24	=	19.85			(27)
External wall			14.69	x	0.15	=	2.20			(29a)
Party wall			58.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			30.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.05 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.61 (36)
Total fabric heat loss	(33) + (36) =	26.66 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.39	15.20	15.01	14.08	13.90	12.96	12.96	12.78	13.34	13.90	14.27	14.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.05	41.86	41.68	40.74	40.56	39.63	39.63	39.44	40.00	40.56	40.93	41.30	

Average = ∑(39)1...12/12 = 40.70 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.59	0.59	0.59	0.57	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.58	

Average = ∑(40)1...12/12 = 0.57 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		88.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.87	93.34	89.82	86.30	82.78	79.25	79.25	82.78	86.30	89.82	93.34	96.87	

∑(44)1...12 = 1056.72 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.65	125.64	129.65	113.03	108.45	93.59	86.72	99.51	100.70	117.36	128.11	139.12	

∑(45)1...12 = 1385.52 (45)

Distribution loss 0.15 x (45)m

21.55	18.85	19.45	16.95	16.27	14.04	13.01	14.93	15.11	17.60	19.22	20.87	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	

∑(64)1...12 = 1765.27 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.57	65.08	68.91	62.55	61.86	56.09	54.64	58.89	58.45	64.82	67.57	72.06	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.44	39.47	32.10	24.30	18.17	15.34	16.57	21.54	28.91	36.71	42.84	45.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.59	300.68	292.90	276.33	255.42	235.77	222.64	219.55	227.33	243.90	264.81	284.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	(71)
Water heating gains (Table 5)	98.88	96.84	92.62	86.88	83.15	77.90	73.44	79.15	81.19	87.13	93.84	96.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.14	533.23	513.85	483.74	452.97	425.23	408.87	416.47	433.66	463.96	497.72	523.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	16.06	x	19.64	x 0.9 x	0.50	x	0.90	=	98.36	(80)

Solar gains in watts ∑(74)m...(82)m

98.36	192.42	316.89	462.17	566.40	579.81	552.01	474.17	368.56	228.32	122.65	80.89	(83)

Total gains - internal and solar (73)m + (83)m

635.51	725.65	830.74	945.91	1019.37	1005.05	960.88	890.64	802.21	692.29	620.37	604.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.86	0.72	0.52	0.37	0.25	0.18	0.20	0.34	0.61	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.84	20.93	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.82	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.44	20.44	20.44	20.45	20.46	20.47	20.47	20.47	20.46	20.46	20.45	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.92	0.84	0.69	0.50	0.35	0.23	0.16	0.18	0.32	0.58	0.83	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.24	20.35	20.42	20.45	20.46	20.47	20.47	20.47	20.46	20.45	20.39	20.22	(90)

Living area fraction — Living area ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.43	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.57	20.42	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.43	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.57	20.42	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.85	0.70	0.50	0.36	0.24	0.17	0.19	0.33	0.59	0.84	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	587.71	614.22	579.59	477.35	362.18	239.28	160.03	167.23	261.39	405.37	520.73	567.44	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	678.42	654.70	587.84	477.84	362.20	239.28	160.03	167.23	261.40	406.71	551.22	669.75	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	67.48	27.21	6.14	0.35	0.01	0.00	0.00	0.00	0.00	0.99	21.95	76.12	

∑(98)1...5, 10...12 = 200.26 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11) — '0' if none = 0.00 (301)

Fraction of space heat from community system — 1 - (301) = 1.00 (302)

Fraction of community heat from boilers = 1.00 (303a)

Fraction of total space heat from community boilers — (302) x (303a) = 1.00 (304a)

Factor for control and charging method (Table 4c(3)) for community space heating = 1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating = 1.00 (305a)

Distribution loss factor (Table 12c) for community heating system = 1.05 (306)

Space heating

Annual space heating requirement: 200.26 (98)

Space heat from boilers — (98) x (304a) x (305) x (306) = 210.27 (307a)

Water heating

Annual water heating requirement: 1765.27 (64)

Water heat from boilers — (64) x (303a) x (305a) x (306) = 1853.53 (310a)

Electricity used for heat distribution — 0.01 × [(307a)...(307e) + (310a)...(310e)] = 20.64 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside: 116.23 (330a)

Total electricity for the above, kWh/year = 116.23 (331)

Electricity for lighting (Appendix L) = 313.92 (332)

Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2493.96	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	210.27	x	4.24	x 0.01 =	8.92	(340a)
Water heating from boilers	1853.53	x	4.24	x 0.01 =	78.59	(342a)
Pumps and fans	116.23	x	13.19	x 0.01 =	15.33	(349)
Electricity for lighting	313.92	x	13.19	x 0.01 =	41.41	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		264.24	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.64	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2118.90	x	0.216	=	457.68	(367)
Electrical energy for community heat distribution	20.64	x	0.519	=	10.71	(372)
Total CO2 associated with community systems					468.39	(373)
Total CO2 associated with space and water heating					468.39	(376)
Pumps and fans	116.23	x	0.519	=	60.32	(378)
Electricity for lighting	313.92	x	0.519	=	162.93	(379)
Total CO_2, kg/year				(376)..(382) =	691.64	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.76	(384)
EI value					92.00	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2118.90	x	1.22	=	2585.05	(367)
Electrical energy for community heat distribution	20.64	x	3.07	=	63.36	(372)
Total primary energy associated with community systems					2648.41	(373)
Total primary energy associated with space and water heating					2648.41	(376)
Pumps and fans	116.23	x	3.07	=	356.83	(378)
Electricity for lighting	313.92	x	3.07	=	963.74	(379)
Primary energy kWh/year					3968.99	(383)
Dwelling primary energy rate kWh/m2/year					55.98	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Lo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.90	(1a) x	2.50	(2a) =	177.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.06	x	1.24	=	19.85			(27)
External wall			14.69	x	0.15	=	2.20			(29a)
Party wall			58.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			30.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.05 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.61 (36)
Total fabric heat loss	(33) + (36) =	26.66 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.39	15.20	15.01	14.08	13.90	12.96	12.96	12.78	13.34	13.90	14.27	14.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.05	41.86	41.68	40.74	40.56	39.63	39.63	39.44	40.00	40.56	40.93	41.30	

Average = ∑(39)1...12/12 = 40.70 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.59	0.59	0.59	0.57	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.58	

Average = ∑(40)1...12/12 = 0.57 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		88.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.87	93.34	89.82	86.30	82.78	79.25	79.25	82.78	86.30	89.82	93.34	96.87	

∑(44)1...12 = 1056.72 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.65	125.64	129.65	113.03	108.45	93.59	86.72	99.51	100.70	117.36	128.11	139.12	

∑(45)1...12 = 1385.52 (45)

Distribution loss 0.15 x (45)m

21.55	18.85	19.45	16.95	16.27	14.04	13.01	14.93	15.11	17.60	19.22	20.87	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37

(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37

∑(64)1...12 = 1765.27 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.57	65.08	68.91	62.55	61.86	56.09	54.64	58.89	58.45	64.82	67.57	72.06

(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.44	39.47	32.10	24.30	18.17	15.34	16.57	21.54	28.91	36.71	42.84	45.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.59	300.68	292.90	276.33	255.42	235.77	222.64	219.55	227.33	243.90	264.81	284.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	(71)
Water heating gains (Table 5)	98.88	96.84	92.62	86.88	83.15	77.90	73.44	79.15	81.19	87.13	93.84	96.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.14	533.23	513.85	483.74	452.97	425.23	408.87	416.47	433.66	463.96	497.72	523.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	16.06	x	19.64	x 0.9 x	0.50	x	0.90	=	98.36	(80)

Solar gains in watts ∑(74)m...(82)m

98.36	192.42	316.89	462.17	566.40	579.81	552.01	474.17	368.56	228.32	122.65	80.89

(83)

Total gains - internal and solar (73)m + (83)m

635.51	725.65	830.74	945.91	1019.37	1005.05	960.88	890.64	802.21	692.29	620.37	604.11

(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.86	0.72	0.52	0.37	0.25	0.18	0.20	0.34	0.61	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.84	20.93	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.82	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.44	20.44	20.44	20.45	20.46	20.47	20.47	20.47	20.46	20.46	20.45	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.92	0.84	0.69	0.50	0.35	0.23	0.16	0.18	0.32	0.58	0.83	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.24	20.35	20.42	20.45	20.46	20.47	20.47	20.47	20.46	20.45	20.39	20.22	(90)

Living area fraction — Living area ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.43	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.57	20.42	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.43	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.57	20.42	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.85	0.70	0.50	0.36	0.24	0.17	0.19	0.33	0.59	0.84	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	587.71	614.22	579.59	477.35	362.18	239.28	160.03	167.23	261.39	405.37	520.73	567.44	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	678.42	654.70	587.84	477.84	362.20	239.28	160.03	167.23	261.40	406.71	551.22	669.75	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	67.48	27.21	6.14	0.35	0.01	0.00	0.00	0.00	0.00	0.99	21.95	76.12	

∑(98)1...5, 10...12 = 200.26 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	200.26		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	42.05	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	168.22	(307b)

Water heating

Annual water heating requirement	1765.27		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.71	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.82	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.64	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.23		(330a)
Total electricity for the above, kWh/year		116.23	(331)
Electricity for lighting (Appendix L)		313.92	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2493.96	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	42.05	x	2.97	x 0.01 =	1.25	(340a)
Space heating from boilers	168.22	x	4.24	x 0.01 =	7.13	(340b)
Water heating from CHP	370.71	x	2.97	x 0.01 =	11.01	(342a)
Water heating from boilers	1482.82	x	4.24	x 0.01 =	62.87	(342b)
Pumps and fans	116.23	x	13.19	x 0.01 =	15.33	(349)
Electricity for lighting	313.92	x	13.19	x 0.01 =	41.41	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		259.00	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.94	(357)
SAP value	86.91	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	77.8158	x	0.2160	=	16.8082	(363)
less credit emissions for electricity		-25.8005	x	0.5190	=	-13.3905	(364)
Water heated by CHP		685.9326	x	0.2160	=	148.1614	(365)
less credit emissions for electricity		-227.4271	x	0.5190	=	-118.0347	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1695.12	x	0.216	=	366.15	(368)
Electrical energy for community heat distribution		20.64	x	0.519	=	10.71	(372)
Total CO2 associated with community systems						410.40	(373)
Total CO2 associated with space and water heating						410.40	(376)
Pumps and fans		116.23	x	0.519	=	60.32	(378)
Electricity for lighting		313.92	x	0.519	=	162.93	(379)
Total CO_2, kg/year					(376)..(382) =	633.65	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	8.94	(384)
EI value						92.67	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	77.82	x	1.22	=	94.94	(363)
less credit energy for electricity		-25.80	x	3.07	=	-79.21	(364)
Water heated by CHP		685.93	x	1.22	=	836.84	(365)
less credit energy for electricity		-227.43	x	3.07	=	-698.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1695.12	x	1.22	=	2068.04	(368)
Electrical energy for community heat distribution		20.64	x	3.07	=	63.36	(372)
Total primary energy associated with community systems						2285.77	(373)
Total primary energy associated with space and water heating						2285.77	(376)
Pumps and fans		116.23	x	3.07	=	356.83	(378)
Electricity for lighting		313.92	x	3.07	=	963.74	(379)
Primary energy kWh/year						3606.34	(383)
Dwelling primary energy rate kWh/m2/year						50.87	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Lo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.90	(1a) x	2.50	(2a) =	177.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.06	x	1.24	=	19.85			(27)
External wall			14.69	x	0.15	=	2.20			(29a)
Party wall			58.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			30.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.05 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.61 (36)
Total fabric heat loss	(33) + (36) =	26.66 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.39	15.20	15.01	14.08	13.90	12.96	12.96	12.78	13.34	13.90	14.27	14.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.05	41.86	41.68	40.74	40.56	39.63	39.63	39.44	40.00	40.56	40.93	41.30	

Average = ∑(39)1...12/12 = 40.70 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.59	0.59	0.59	0.57	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.58	

Average = ∑(40)1...12/12 = 0.57 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		88.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.87	93.34	89.82	86.30	82.78	79.25	79.25	82.78	86.30	89.82	93.34	96.87	

∑(44)1...12 = 1056.72 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.65	125.64	129.65	113.03	108.45	93.59	86.72	99.51	100.70	117.36	128.11	139.12	

∑(45)1...12 = 1385.52 (45)

Distribution loss 0.15 x (45)m

21.55	18.85	19.45	16.95	16.27	14.04	13.01	14.93	15.11	17.60	19.22	20.87	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	

∑(64)1...12 = 1765.27 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.57	65.08	68.91	62.55	61.86	56.09	54.64	58.89	58.45	64.82	67.57	72.06	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.44	39.47	32.10	24.30	18.17	15.34	16.57	21.54	28.91	36.71	42.84	45.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.59	300.68	292.90	276.33	255.42	235.77	222.64	219.55	227.33	243.90	264.81	284.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	(71)
Water heating gains (Table 5)	98.88	96.84	92.62	86.88	83.15	77.90	73.44	79.15	81.19	87.13	93.84	96.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.14	533.23	513.85	483.74	452.97	425.23	408.87	416.47	433.66	463.96	497.72	523.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	16.06	x	19.64	x 0.9 x	0.50	x	0.90	=	98.36	(80)

Solar gains in watts ∑(74)m...(82)m

98.36	192.42	316.89	462.17	566.40	579.81	552.01	474.17	368.56	228.32	122.65	80.89	(83)

Total gains - internal and solar (73)m + (83)m

635.51	725.65	830.74	945.91	1019.37	1005.05	960.88	890.64	802.21	692.29	620.37	604.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.86	0.72	0.52	0.37	0.25	0.18	0.20	0.34	0.61	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.84	20.93	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.82	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.44	20.44	20.44	20.45	20.46	20.47	20.47	20.47	20.46	20.46	20.45	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.92	0.84	0.69	0.50	0.35	0.23	0.16	0.18	0.32	0.58	0.83	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.24	20.35	20.42	20.45	20.46	20.47	20.47	20.47	20.46	20.45	20.39	20.22	(90)

Living area fraction — Living area ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.43	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.57	20.42	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.43	20.54	20.60	20.63	20.63	20.64	20.64	20.64	20.64	20.63	20.57	20.42	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.92	0.85	0.70	0.50	0.36	0.24	0.17	0.19	0.33	0.59	0.84	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	587.71	614.22	579.59	477.35	362.18	239.28	160.03	167.23	261.39	405.37	520.73	567.44	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	678.42	654.70	587.84	477.84	362.20	239.28	160.03	167.23	261.40	406.71	551.22	669.75	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	67.48	27.21	6.14	0.35	0.01	0.00	0.00	0.00	0.00	0.99	21.95	76.12	

∑(98)1...5, 10...12 = 200.26 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.82 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	200.26		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	42.05	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	168.22	(307b)

Water heating

Annual water heating requirement	1765.27		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.71	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.82	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.64	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.23		(330a)
Total electricity for the above, kWh/year		116.23	(331)
Electricity for lighting (Appendix L)		313.92	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2260.78	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	42.05	x	2.97	x 0.01 =	1.25	(340a)
Space heating from boilers	168.22	x	4.24	x 0.01 =	7.13	(340b)
Water heating from CHP	370.71	x	2.97	x 0.01 =	11.01	(342a)
Water heating from boilers	1482.82	x	4.24	x 0.01 =	62.87	(342b)
Pumps and fans	116.23	x	13.19	x 0.01 =	15.33	(349)
Electricity for lighting	313.92	x	13.19	x 0.01 =	41.41	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		259.00	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.94	(357)
SAP value	86.91	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	77.8158	x	0.2160	=	16.8082	(363)
less credit emissions for electricity		-25.8005	x	0.5190	=	-13.3905	(364)
Water heated by CHP		685.9326	x	0.2160	=	148.1614	(365)
less credit emissions for electricity		-227.4271	x	0.5190	=	-118.0347	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1695.12	x	0.216	=	366.15	(368)
Electrical energy for community heat distribution		20.64	x	0.519	=	10.71	(372)
Total CO2 associated with community systems						410.40	(373)
Total CO2 associated with space and water heating						410.40	(376)
Pumps and fans		116.23	x	0.519	=	60.32	(378)
Electricity for lighting		313.92	x	0.519	=	162.93	(379)
Energy saving/generation technologies							
pv savings		-233.18	x	0.519	=	-121.02	(380)

Total CO_2, kg/year	(376)..(382) =	512.63	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	7.23	(384)
EI value		94.07	
EI rating (section 14)		94	(385)
EI band		A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	77.82	x	1.22	=	94.94	(363)
less credit energy for electricity		-25.80	x	3.07	=	-79.21	(364)
Water heated by CHP		685.93	x	1.22	=	836.84	(365)
less credit energy for electricity		-227.43	x	3.07	=	-698.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1695.12	x	1.22	=	2068.04	(368)
Electrical energy for community heat distribution		20.64	x	3.07	=	63.36	(372)
Total primary energy associated with community systems						2285.77	(373)
Total primary energy associated with space and water heating						2285.77	(376)
Pumps and fans		116.23	x	3.07	=	356.83	(378)
Electricity for lighting		313.92	x	3.07	=	963.74	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2890.49	(383)
Dwelling primary energy rate kWh/m2/year						40.77	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Lr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.90	(1a) x	2.50	(2a) =	177.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.06	x	1.24	=	19.85			(27)
External wall			14.69	x	0.15	=	2.20			(29a)
Party wall			58.75	x	0.00	=	0.00			(32)
Roof			70.90	x	0.12	=	8.51			(30)
Total area of external elements ∑A, m²			101.65							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.56 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.25 (36)
Total fabric heat loss	(33) + (36) =	45.81 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.39	15.20	15.01	14.08	13.90	12.96	12.96	12.78	13.34	13.90	14.27	14.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

61.19	61.01	60.82	59.89	59.70	58.77	58.77	58.58	59.14	59.70	60.07	60.45	

Average = ∑(39)1...12/12 = 59.84 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.86	0.86	0.86	0.84	0.84	0.83	0.83	0.83	0.83	0.84	0.85	0.85	

Average = ∑(40)1...12/12 = 0.84 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.87	93.34	89.82	86.30	82.78	79.25	79.25	82.78	86.30	89.82	93.34	96.87	

∑(44)1...12 = 1056.72 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.65	125.64	129.65	113.03	108.45	93.59	86.72	99.51	100.70	117.36	128.11	139.12	

∑(45)1...12 = 1385.52 (45)

Distribution loss 0.15 x (45)m

21.55	18.85	19.45	16.95	16.27	14.04	13.01	14.93	15.11	17.60	19.22	20.87	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	

∑(64)1...12 = 1765.27 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.57	65.08	68.91	62.55	61.86	56.09	54.64	58.89	58.45	64.82	67.57	72.06	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.44	39.47	32.10	24.30	18.17	15.34	16.57	21.54	28.91	36.71	42.84	45.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.59	300.68	292.90	276.33	255.42	235.77	222.64	219.55	227.33	243.90	264.81	284.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	(71)
Water heating gains (Table 5)	98.88	96.84	92.62	86.88	83.15	77.90	73.44	79.15	81.19	87.13	93.84	96.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.14	533.23	513.85	483.74	452.97	425.23	408.87	416.47	433.66	463.96	497.72	523.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	16.06	x	19.64	x 0.9 x	0.50	x	0.90	=	98.36	(80)

Solar gains in watts ∑(74)m...(82)m

98.36	192.42	316.89	462.17	566.40	579.81	552.01	474.17	368.56	228.32	122.65	80.89	(83)

Total gains - internal and solar (73)m + (83)m

635.51	725.65	830.74	945.91	1019.37	1005.05	960.88	890.64	802.21	692.29	620.37	604.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.89	0.73	0.54	0.37	0.27	0.30	0.51	0.82	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.44	20.60	20.80	20.95	20.99	21.00	21.00	21.00	21.00	20.92	20.66	20.41	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.20	20.20	20.20	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.95	0.87	0.69	0.50	0.33	0.22	0.25	0.45	0.77	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.48	19.70	19.97	20.17	20.21	20.23	20.23	20.23	20.22	20.14	19.80	19.44	(90)

Living area fraction — Living area ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.79	19.99	20.24	20.42	20.46	20.48	20.48	20.48	20.47	20.39	20.08	19.75	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.79	19.99	20.24	20.42	20.46	20.48	20.48	20.48	20.47	20.39	20.08	19.75	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.70	0.51	0.34	0.24	0.27	0.47	0.78	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	618.13	684.92	720.46	663.14	519.78	345.13	227.80	238.87	375.36	542.32	585.00	591.05	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	947.72	920.38	835.47	689.78	523.14	345.33	227.81	238.90	376.78	584.44	779.57	940.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	245.21	158.23	85.57	19.18	2.50	0.00	0.00	0.00	0.00	31.34	140.09	259.66	

∑(98)1...5, 10...12 = 941.78 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.28 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	941.78		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	988.87	(307a)

Water heating

Annual water heating requirement	1765.27		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1853.53	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.42	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	116.23		(330a)
Total electricity for the above, kWh/year		116.23	(331)

Electricity for lighting (Appendix L)		313.92	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3272.56	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	988.87	x	4.24	x 0.01 =	41.93	(340a)
Water heating from boilers	1853.53	x	4.24	x 0.01 =	78.59	(342a)
Pumps and fans	116.23	x	13.19	x 0.01 =	15.33	(349)
Electricity for lighting	313.92	x	13.19	x 0.01 =	41.41	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		297.26	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.97	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2918.28	x	0.216	=	630.35	(367)
Electrical energy for community heat distribution	28.42	x	0.519	=	14.75	(372)
Total CO2 associated with community systems					645.10	(373)
Total CO2 associated with space and water heating					645.10	(376)
Pumps and fans	116.23	x	0.519	=	60.32	(378)
Electricity for lighting	313.92	x	0.519	=	162.93	(379)
Total CO_2, kg/year				(376)..(382) =	868.35	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.25	(384)
EI value					89.96	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2918.28	x	1.22	=	3560.30	(367)
Electrical energy for community heat distribution	28.42	x	3.07	=	87.26	(372)
Total primary energy associated with community systems					3647.56	(373)
Total primary energy associated with space and water heating					3647.56	(376)
Pumps and fans	116.23	x	3.07	=	356.83	(378)
Electricity for lighting	313.92	x	3.07	=	963.74	(379)
Primary energy kWh/year					4968.13	(383)
Dwelling primary energy rate kWh/m2/year					70.07	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ir 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.00	(1a) x	2.50	(2a) =	237.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	237.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			18.89	x	1.24	=	23.34			(27)
Door			1.89	x	1.00	=	1.89			(26)
External wall			45.47	x	0.15	=	6.82			(29a)
Party wall			76.25	x	0.00	=	0.00			(32)
Roof			67.20	x	0.12	=	8.06			(30)
Total area of external elements ∑A, m²			133.45							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.12 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.02 (36)
Total fabric heat loss	(33) + (36) =	60.14 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.62	20.37	20.12	18.87	18.62	17.37	17.37	17.12	17.87	18.62	19.12	19.62	(38)

Heat transfer coefficient, W/K (37)m + (38)m

80.75	80.50	80.25	79.00	78.75	77.51	77.51	77.26	78.00	78.75	79.25	79.75	

Average = ∑(39)1...12/12 = 78.94 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.85	0.84	0.83	0.83	0.82	0.82	0.81	0.82	0.83	0.83	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		98.04 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
107.85	103.93	100.00	96.08	92.16	88.24	88.24	92.16	96.08	100.00	103.93	107.85	

∑(44)1...12 = 1176.53 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

159.94	139.88	144.34	125.84	120.75	104.20	96.55	110.80	112.12	130.67	142.63	154.89	

∑(45)1...12 = 1542.61 (45)

Distribution loss 0.15 x (45)m

23.99	20.98	21.65	18.88	18.11	15.63	14.48	16.62	16.82	19.60	21.39	23.23	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.23 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.23 (50)
Enter (50) or (54) in (55)	0.23 (55)

Water storage loss calculated for each month (55) x (41)m

7.13	6.44	7.13	6.90	7.13	6.90	7.13	7.13	6.90	7.13	6.90	7.13	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

7.13	6.44	7.13	6.90	7.13	6.90	7.13	7.13	6.90	7.13	6.90	7.13	(57)

Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss for each month from Table 3a, 3b or 3c

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

	190.33	167.33	174.74	155.26	151.14	133.61	126.95	141.19	141.53	161.06	172.04	185.28 (62)

Solar DHW input calculated using Appendix G or Appendix H

	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (63)

Output from water heater for each month (kWh/month) (62)m + (63)m

	190.33	167.33	174.74	155.26	151.14	133.61	126.95	141.19	141.53	161.06	172.04	185.28

∑(64)1...12 = 1900.46 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

	77.49	68.47	72.31	65.37	64.46	58.18	56.42	61.15	60.81	67.76	70.95	75.81 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	161.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.27	49.09	39.92	30.22	22.59	19.07	20.61	26.79	35.96	45.66	53.29	56.81	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.12	373.96	364.28	343.68	317.67	293.23	276.90	273.05	282.73	303.34	329.35	353.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	53.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	-107.53	(71)
Water heating gains (Table 5)	104.16	101.89	97.19	90.80	86.64	80.80	75.83	82.20	84.46	91.08	98.55	101.90	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	637.13	632.53	608.98	572.28	534.49	500.68	480.92	489.62	510.73	547.65	588.76	620.08	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	12.56	x	46.75	x 0.9 x	0.50	x	0.90	=	183.12	(78)
North	0.77	x	1.65	x	10.63	x 0.9 x	0.50	x	0.90	=	5.47	(74)
East	0.77	x	2.04	x	19.64	x 0.9 x	0.50	x	0.90	=	12.49	(76)
West	0.77	x	2.64	x	19.64	x 0.9 x	0.50	x	0.90	=	16.17	(80)

Solar gains in watts ∑(74)m...(82)m

	217.26	366.43	492.14	594.99	653.43	643.12	622.35	579.52	527.83	402.46	259.55	186.37 (83)

Total gains - internal and solar (73)m + (83)m

	854.39	998.96	1101.11	1167.27	1187.92	1143.80	1103.27	1069.14	1038.56	950.11	848.31	806.45 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

	0.98	0.95	0.89	0.77	0.61	0.43	0.31	0.33	0.52	0.80	0.95	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

	20.47	20.64	20.81	20.94	20.99	21.00	21.00	21.00	21.00	20.93	20.69	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.21	20.21	20.21	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.22	20.22	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.87	0.73	0.56	0.38	0.26	0.28	0.46	0.75	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.52	19.76	19.99	20.16	20.22	20.24	20.24	20.24	20.23	20.16	19.85	19.47	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.83	20.05	20.26	20.42	20.47	20.49	20.49	20.49	20.49	20.42	20.13	19.79	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.83	20.05	20.26	20.42	20.47	20.49	20.49	20.49	20.49	20.42	20.13	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.74	0.57	0.40	0.27	0.30	0.48	0.76	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	830.06	934.74	955.29	863.90	682.62	455.98	301.59	316.15	496.16	726.34	794.27	788.88	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1254.25	1219.69	1104.31	910.01	690.90	456.58	301.63	316.22	498.14	773.27	1032.52	1243.32	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	315.59	191.49	110.87	33.20	6.16	0.00	0.00	0.00	0.00	34.91	171.54	338.10	

∑(98)1...5, 10...12 = 1201.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.65 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1201.88		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	252.39	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1009.58	(307b)

Water heating

Annual water heating requirement	1900.46		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	399.10	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1596.39	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	32.57	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	191.96		(330a)
Total electricity for the above, kWh/year		191.96	(331)
Electricity for lighting (Appendix L)		390.43	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3839.84	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	252.39	x	2.97	x 0.01 =	7.50	(340a)
Space heating from boilers	1009.58	x	4.24	x 0.01 =	42.81	(340b)
Water heating from CHP	399.10	x	2.97	x 0.01 =	11.85	(342a)
Water heating from boilers	1596.39	x	4.24	x 0.01 =	67.69	(342b)
Pumps and fans	191.96	x	13.19	x 0.01 =	25.32	(349)
Electricity for lighting	390.43	x	13.19	x 0.01 =	51.50	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		326.66	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.98	(357)
SAP value	86.33	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	467.0145	x	0.2160	=	100.8751	(363)
less credit emissions for electricity		-154.8428	x	0.5190	=	-80.3634	(364)
Water heated by CHP		738.4647	x	0.2160	=	159.5084	(365)
less credit emissions for electricity		-244.8446	x	0.5190	=	-127.0743	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2675.53	x	0.216	=	577.91	(368)
Electrical energy for community heat distribution		32.57	x	0.519	=	16.91	(372)
Total CO2 associated with community systems						647.77	(373)
Total CO2 associated with space and water heating						647.77	(376)
Pumps and fans		191.96	x	0.519	=	99.63	(378)
Electricity for lighting		390.43	x	0.519	=	202.63	(379)
Total CO_2, kg/year					(376)..(382) =	950.03	(383)

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Dwelling CO_2 emission rate	(383) ÷ (4) =	10.00	(384)
EI value		90.91	
EI rating (section 14)		91	(385)
EI band		B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	467.01	x	1.22	=	569.76	(363)
less credit energy for electricity		-154.84	x	3.07	=	-475.37	(364)
Water heated by CHP		738.46	x	1.22	=	900.93	(365)
less credit energy for electricity		-244.84	x	3.07	=	-751.67	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2675.53	x	1.22	=	3264.14	(368)
Electrical energy for community heat distribution		32.57	x	3.07	=	100.00	(372)
Total primary energy associated with community systems						3607.79	(373)
Total primary energy associated with space and water heating						3607.79	(376)
Pumps and fans		191.96	x	3.07	=	589.32	(378)
Electricity for lighting		390.43	x	3.07	=	1198.62	(379)
Primary energy kWh/year						5395.73	(383)
Dwelling primary energy rate kWh/m2/year						56.80	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Lr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.90	(1a) x	2.50	(2a) =	177.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.06	x	1.24	=	19.85			(27)
External wall			14.69	x	0.15	=	2.20			(29a)
Party wall			58.75	x	0.00	=	0.00			(32)
Roof			70.90	x	0.12	=	8.51			(30)
Total area of external elements ∑A, m²			101.65							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.56 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.25 (36)
Total fabric heat loss	(33) + (36) =	45.81 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.39	15.20	15.01	14.08	13.90	12.96	12.96	12.78	13.34	13.90	14.27	14.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

61.19	61.01	60.82	59.89	59.70	58.77	58.77	58.58	59.14	59.70	60.07	60.45	

Average = ∑(39)1...12/12 = 59.84 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.86	0.86	0.86	0.84	0.84	0.83	0.83	0.83	0.83	0.84	0.85	0.85	

Average = ∑(40)1...12/12 = 0.84 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N: 2.27 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 88.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.87	93.34	89.82	86.30	82.78	79.25	79.25	82.78	86.30	89.82	93.34	96.87	

∑(44)1...12 = 1056.72 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.65	125.64	129.65	113.03	108.45	93.59	86.72	99.51	100.70	117.36	128.11	139.12	

∑(45)1...12 = 1385.52 (45)

Distribution loss 0.15 x (45)m

21.55	18.85	19.45	16.95	16.27	14.04	13.01	14.93	15.11	17.60	19.22	20.87	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel: 1.00 (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.29 (48)

Temperature factor from Table 2b: 1.00 (49)

Energy lost from water storage (kWh/day) (48) x (49): 0.29 (50)

Enter (50) or (54) in (55): 0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.90	154.77	161.90	144.24	140.71	124.80	118.97	131.77	131.92	149.61	159.32	171.37	

∑(64)1...12 = 1765.27 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.57	65.08	68.91	62.55	61.86	56.09	54.64	58.89	58.45	64.82	67.57	72.06	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	136.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.44	39.47	32.10	24.30	18.17	15.34	16.57	21.54	28.91	36.71	42.84	45.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.59	300.68	292.90	276.33	255.42	235.77	222.64	219.55	227.33	243.90	264.81	284.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	-90.71	(71)
Water heating gains (Table 5)	98.88	96.84	92.62	86.88	83.15	77.90	73.44	79.15	81.19	87.13	93.84	96.85	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.14	533.23	513.85	483.74	452.97	425.23	408.87	416.47	433.66	463.96	497.72	523.22	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	16.06	x	19.64	x 0.9 x	0.50	x	0.90	=	98.36	(80)

Solar gains in watts ∑(74)m...(82)m

98.36	192.42	316.89	462.17	566.40	579.81	552.01	474.17	368.56	228.32	122.65	80.89	(83)

Total gains - internal and solar (73)m + (83)m

635.51	725.65	830.74	945.91	1019.37	1005.05	960.88	890.64	802.21	692.29	620.37	604.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.89	0.73	0.54	0.37	0.27	0.30	0.51	0.82	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.44	20.60	20.80	20.95	20.99	21.00	21.00	21.00	21.00	20.92	20.66	20.41	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.20	20.20	20.20	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.95	0.87	0.69	0.50	0.33	0.22	0.25	0.45	0.77	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.48	19.70	19.97	20.17	20.21	20.23	20.23	20.23	20.22	20.14	19.80	19.44	(90)

Living area fraction — Living area ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.79	19.99	20.24	20.42	20.46	20.48	20.48	20.48	20.47	20.39	20.08	19.75	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.79	19.99	20.24	20.42	20.46	20.48	20.48	20.48	20.47	20.39	20.08	19.75	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.70	0.51	0.34	0.24	0.27	0.47	0.78	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	618.13	684.92	720.46	663.14	519.78	345.13	227.80	238.87	375.36	542.32	585.00	591.05	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	947.72	920.38	835.47	689.78	523.14	345.33	227.81	238.90	376.78	584.44	779.57	940.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	245.21	158.23	85.57	19.18	2.50	0.00	0.00	0.00	0.00	31.34	140.09	259.66	

∑(98)1...5, 10...12 = 941.78 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.28 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	941.78		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	197.77	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	791.10	(307b)

Water heating

Annual water heating requirement	1765.27		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.71	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1482.82	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.42	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.23		(330a)
Total electricity for the above, kWh/year		116.23	(331)
Electricity for lighting (Appendix L)		313.92	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3039.38	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	197.77	x	2.97	x 0.01 =	5.87	(340a)
Space heating from boilers	791.10	x	4.24	x 0.01 =	33.54	(340b)
Water heating from CHP	370.71	x	2.97	x 0.01 =	11.01	(342a)
Water heating from boilers	1482.82	x	4.24	x 0.01 =	62.87	(342b)
Pumps and fans	116.23	x	13.19	x 0.01 =	15.33	(349)
Electricity for lighting	313.92	x	13.19	x 0.01 =	41.41	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		290.04	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.34	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	365.9491	x	0.2160	=	79.0450	(363)
less credit emissions for electricity		-121.3337	x	0.5190	=	-62.9722	(364)
Water heated by CHP		685.9326	x	0.2160	=	148.1614	(365)
less credit emissions for electricity		-227.4271	x	0.5190	=	-118.0347	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2334.62	x	0.216	=	504.28	(368)
Electrical energy for community heat distribution		28.42	x	0.519	=	14.75	(372)
Total CO2 associated with community systems						565.23	(373)
Total CO2 associated with space and water heating						565.23	(376)
Pumps and fans		116.23	x	0.519	=	60.32	(378)
Electricity for lighting		313.92	x	0.519	=	162.93	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	667.46	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.41	(384)
EI value					92.28	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	365.95	x	1.22	=	446.46	(363)
less credit energy for electricity		-121.33	x	3.07	=	-372.49	(364)
Water heated by CHP		685.93	x	1.22	=	836.84	(365)
less credit energy for electricity		-227.43	x	3.07	=	-698.20	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2334.62	x	1.22	=	2848.24	(368)
Electrical energy for community heat distribution		28.42	x	3.07	=	87.26	(372)
Total primary energy associated with community systems						3148.10	(373)
Total primary energy associated with space and water heating						3148.10	(376)
Pumps and fans		116.23	x	3.07	=	356.83	(378)
Electricity for lighting		313.92	x	3.07	=	963.74	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3752.82	(383)
Dwelling primary energy rate kWh/m2/year						52.93	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Mf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		71.00	(1a) x	2.50	(2a) =	177.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	71.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.60	x	1.24	=	20.51			(27)
Exposed floor			71.00	x	0.10	=	7.10			(28b
External wall			14.40	x	0.15	=	2.16			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			102.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.77 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.30 (36)
Total fabric heat loss	(33) + (36) =	45.07 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.41	15.22	15.04	14.10	13.92	12.98	12.98	12.79	13.36	13.92	14.29	14.66	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.48	60.30	60.11	59.18	58.99	58.05	58.05	57.87	58.43	58.99	59.36	59.74	

Average = ∑(39)1...12/12 = 59.13 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.85	0.85	0.83	0.83	0.82	0.82	0.82	0.82	0.83	0.84	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.12 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.93	93.40	89.88	86.35	82.83	79.30	79.30	82.83	86.35	89.88	93.40	96.93	

∑(44)1...12 = 1057.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.74	125.72	129.73	113.10	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21	

∑(45)1...12 = 1386.41 (45)

Distribution loss 0.15 x (45)m

21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	

∑(64)1...12 = 1766.16 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.60	65.11	68.94	62.58	61.89	56.11	54.66	58.91	58.47	64.85	67.59	72.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.49	39.52	32.14	24.33	18.19	15.35	16.59	21.56	28.94	36.75	42.89	45.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.94	301.03	293.24	276.65	255.72	236.04	222.89	219.80	227.59	244.18	265.12	284.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)
Water heating gains (Table 5)	98.92	96.88	92.66	86.91	83.18	77.93	73.46	79.18	81.22	87.16	93.88	96.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.64	533.73	514.33	484.19	453.38	425.61	409.24	416.84	434.05	464.39	498.18	523.71	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	16.60	x	19.64	x 0.9 x	0.50	x	0.90	=	101.67	(76)

Solar gains in watts ∑(74)m...(82)m

101.67	198.89	327.55	477.71	585.45	599.31	570.57	490.11	380.95	236.00	126.77	83.61	(83)

Total gains - internal and solar (73)m + (83)m

639.32	732.62	841.87	961.90	1038.83	1024.93	979.81	906.95	815.00	700.39	624.96	607.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.88	0.71	0.52	0.36	0.26	0.29	0.49	0.80	0.96	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.46	20.62	20.82	20.96	20.99	21.00	21.00	21.00	21.00	20.93	20.68	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.21	20.21	20.21	20.22	20.23	20.24	20.24	20.24	20.23	20.23	20.22	20.22	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.86	0.68	0.48	0.32	0.22	0.25	0.44	0.76	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.51	19.74	20.00	20.18	20.22	20.24	20.24	20.24	20.23	20.16	19.83	19.48	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.87	20.07	20.31	20.47	20.51	20.52	20.52	20.53	20.52	20.45	20.15	19.83	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.87	20.07	20.31	20.47	20.51	20.52	20.52	20.53	20.52	20.45	20.15	19.83	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.69	0.50	0.34	0.23	0.26	0.46	0.77	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	621.32	689.52	723.91	661.84	517.07	343.76	227.82	238.73	373.89	542.61	587.96	593.85	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	941.75	914.55	830.01	684.90	519.83	343.92	227.83	238.75	375.07	580.86	774.69	933.95	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	238.40	151.22	78.94	16.60	2.05	0.00	0.00	0.00	0.00	28.46	134.44	253.04	

∑(98)1...5, 10...12 = 903.15 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.72 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	903.15		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	948.31	(307a)

Water heating

Annual water heating requirement	1766.16		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1854.46	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.03	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	108.28		(330a)
Total electricity for the above, kWh/year		108.28	(331)

Electricity for lighting (Appendix L)		314.29	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3225.34	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	948.31	x	4.24	x 0.01 =	40.21	(340a)
Water heating from boilers	1854.46	x	4.24	x 0.01 =	78.63	(342a)
Pumps and fans	108.28	x	13.19	x 0.01 =	14.28	(349)
Electricity for lighting	314.29	x	13.19	x 0.01 =	41.45	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		294.57	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.12	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2877.59	x	0.216	=	621.56	(367)
Electrical energy for community heat distribution	28.03	x	0.519	=	14.55	(372)
Total CO2 associated with community systems					636.11	(373)
Total CO2 associated with space and water heating					636.11	(376)
Pumps and fans	108.28	x	0.519	=	56.19	(378)
Electricity for lighting	314.29	x	0.519	=	163.12	(379)
Total CO_2, kg/year				(376)..(382) =	855.42	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.05	(384)
EI value					90.12	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2877.59	x	1.22	=	3510.67	(367)
Electrical energy for community heat distribution	28.03	x	3.07	=	86.05	(372)
Total primary energy associated with community systems					3596.71	(373)
Total primary energy associated with space and water heating					3596.71	(376)
Pumps and fans	108.28	x	3.07	=	332.40	(378)
Electricity for lighting	314.29	x	3.07	=	964.86	(379)
Primary energy kWh/year					4893.98	(383)
Dwelling primary energy rate kWh/m2/year					68.93	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Mf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		71.00	(1a) x	2.50	(2a) =	177.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	71.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.60	x	1.24	=	20.51			(27)
Exposed floor			71.00	x	0.10	=	7.10			(28b
External wall			14.40	x	0.15	=	2.16			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			102.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.77 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.30 (36)
Total fabric heat loss	(33) + (36) =	45.07 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.41	15.22	15.04	14.10	13.92	12.98	12.98	12.79	13.36	13.92	14.29	14.66	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.48	60.30	60.11	59.18	58.99	58.05	58.05	57.87	58.43	58.99	59.36	59.74	

Average = ∑(39)1...12/12 = 59.13 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.85	0.85	0.83	0.83	0.82	0.82	0.82	0.82	0.83	0.84	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.12 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.93	93.40	89.88	86.35	82.83	79.30	79.30	82.83	86.35	89.88	93.40	96.93	

∑(44)1...12 = 1057.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.74	125.72	129.73	113.10	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21	

∑(45)1...12 = 1386.41 (45)

Distribution loss 0.15 x (45)m

21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	

∑(64)1...12 = 1766.16 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.60	65.11	68.94	62.58	61.89	56.11	54.66	58.91	58.47	64.85	67.59	72.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.49	39.52	32.14	24.33	18.19	15.35	16.59	21.56	28.94	36.75	42.89	45.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.94	301.03	293.24	276.65	255.72	236.04	222.89	219.80	227.59	244.18	265.12	284.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)
Water heating gains (Table 5)	98.92	96.88	92.66	86.91	83.18	77.93	73.46	79.18	81.22	87.16	93.88	96.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.64	533.73	514.33	484.19	453.38	425.61	409.24	416.84	434.05	464.39	498.18	523.71	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	16.60	x	19.64	x 0.9 x	0.50	x	0.90	=	101.67	(76)

Solar gains in watts ∑(74)m...(82)m

101.67	198.89	327.55	477.71	585.45	599.31	570.57	490.11	380.95	236.00	126.77	83.61	(83)

Total gains - internal and solar (73)m + (83)m

639.32	732.62	841.87	961.90	1038.83	1024.93	979.81	906.95	815.00	700.39	624.96	607.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.88	0.71	0.52	0.36	0.26	0.29	0.49	0.80	0.96	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.46	20.62	20.82	20.96	20.99	21.00	21.00	21.00	21.00	20.93	20.68	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.21	20.21	20.21	20.22	20.23	20.24	20.24	20.24	20.23	20.23	20.22	20.22	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.86	0.68	0.48	0.32	0.22	0.25	0.44	0.76	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.51	19.74	20.00	20.18	20.22	20.24	20.24	20.24	20.23	20.16	19.83	19.48	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.87	20.07	20.31	20.47	20.51	20.52	20.52	20.53	20.52	20.45	20.15	19.83	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.87	20.07	20.31	20.47	20.51	20.52	20.52	20.53	20.52	20.45	20.15	19.83	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.69	0.50	0.34	0.23	0.26	0.46	0.77	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	621.32	689.52	723.91	661.84	517.07	343.76	227.82	238.73	373.89	542.61	587.96	593.85	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	941.75	914.55	830.01	684.90	519.83	343.92	227.83	238.75	375.07	580.86	774.69	933.95	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	238.40	151.22	78.94	16.60	2.05	0.00	0.00	0.00	0.00	28.46	134.44	253.04	

∑(98)1...5, 10...12 = 903.15 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.72 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	903.15		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	189.66	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	758.65	(307b)

Water heating

Annual water heating requirement	1766.16		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.89	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1483.57	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.03	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	108.28		(330a)
Total electricity for the above, kWh/year		108.28	(331)
Electricity for lighting (Appendix L)		314.29	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3225.34	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	189.66	x	2.97	x 0.01 =	5.63	(340a)
Space heating from boilers	758.65	x	4.24	x 0.01 =	32.17	(340b)
Water heating from CHP	370.89	x	2.97	x 0.01 =	11.02	(342a)
Water heating from boilers	1483.57	x	4.24	x 0.01 =	62.90	(342b)
Pumps and fans	108.28	x	13.19	x 0.01 =	14.28	(349)
Electricity for lighting	314.29	x	13.19	x 0.01 =	41.45	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		287.45	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.48	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	350.9403	x	0.2160	=	75.8031	(363)
less credit emissions for electricity		-116.3574	x	0.5190	=	-60.3895	(364)
Water heated by CHP		686.2783	x	0.2160	=	148.2361	(365)
less credit emissions for electricity		-227.5417	x	0.5190	=	-118.0941	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2302.08	x	0.216	=	497.25	(368)
Electrical energy for community heat distribution		28.03	x	0.519	=	14.55	(372)
Total CO2 associated with community systems						557.35	(373)
Total CO2 associated with space and water heating						557.35	(376)
Pumps and fans		108.28	x	0.519	=	56.19	(378)
Electricity for lighting		314.29	x	0.519	=	163.12	(379)
Total CO_2, kg/year					(376)..(382) =	776.66	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.94	(384)
EI value						91.03	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	350.94	x	1.22	=	428.15	(363)
less credit energy for electricity		-116.36	x	3.07	=	-357.22	(364)
Water heated by CHP		686.28	x	1.22	=	837.26	(365)
less credit energy for electricity		-227.54	x	3.07	=	-698.55	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2302.08	x	1.22	=	2808.53	(368)
Electrical energy for community heat distribution		28.03	x	3.07	=	86.05	(372)
Total primary energy associated with community systems						3104.21	(373)
Total primary energy associated with space and water heating						3104.21	(376)
Pumps and fans		108.28	x	3.07	=	332.40	(378)
Electricity for lighting		314.29	x	3.07	=	964.86	(379)
Primary energy kWh/year						4401.48	(383)
Dwelling primary energy rate kWh/m2/year						61.99	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Mf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		71.00	(1a) x	2.50	(2a) =	177.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	71.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.60	x	1.24	=	20.51			(27)
Exposed floor			71.00	x	0.10	=	7.10			(28b
External wall			14.40	x	0.15	=	2.16			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			102.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.77 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.30 (36)
Total fabric heat loss	(33) + (36) =	45.07 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.41	15.22	15.04	14.10	13.92	12.98	12.98	12.79	13.36	13.92	14.29	14.66	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.48	60.30	60.11	59.18	58.99	58.05	58.05	57.87	58.43	58.99	59.36	59.74	

Average = ∑(39)1...12/12 = 59.13 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.85	0.85	0.83	0.83	0.82	0.82	0.82	0.82	0.83	0.84	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.12 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.93	93.40	89.88	86.35	82.83	79.30	79.30	82.83	86.35	89.88	93.40	96.93	

∑(44)1...12 = 1057.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.74	125.72	129.73	113.10	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21	

∑(45)1...12 = 1386.41 (45)

Distribution loss 0.15 x (45)m

21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	

∑(64)1...12 = 1766.16 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.60	65.11	68.94	62.58	61.89	56.11	54.66	58.91	58.47	64.85	67.59	72.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.49	39.52	32.14	24.33	18.19	15.35	16.59	21.56	28.94	36.75	42.89	45.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.94	301.03	293.24	276.65	255.72	236.04	222.89	219.80	227.59	244.18	265.12	284.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)
Water heating gains (Table 5)	98.92	96.88	92.66	86.91	83.18	77.93	73.46	79.18	81.22	87.16	93.88	96.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.64	533.73	514.33	484.19	453.38	425.61	409.24	416.84	434.05	464.39	498.18	523.71	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	16.60	x	19.64	x 0.9 x	0.50	x	0.90	=	101.67	(76)

Solar gains in watts ∑(74)m...(82)m

101.67	198.89	327.55	477.71	585.45	599.31	570.57	490.11	380.95	236.00	126.77	83.61	(83)

Total gains - internal and solar (73)m + (83)m

639.32	732.62	841.87	961.90	1038.83	1024.93	979.81	906.95	815.00	700.39	624.96	607.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.88	0.71	0.52	0.36	0.26	0.29	0.49	0.80	0.96	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.46	20.62	20.82	20.96	20.99	21.00	21.00	21.00	21.00	20.93	20.68	20.43	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.21	20.21	20.21	20.22	20.23	20.24	20.24	20.24	20.23	20.23	20.22	20.22	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.97	0.94	0.86	0.68	0.48	0.32	0.22	0.25	0.44	0.76	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.51	19.74	20.00	20.18	20.22	20.24	20.24	20.24	20.23	20.16	19.83	19.48	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.87	20.07	20.31	20.47	20.51	20.52	20.52	20.53	20.52	20.45	20.15	19.83	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.87	20.07	20.31	20.47	20.51	20.52	20.52	20.53	20.52	20.45	20.15	19.83	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.86	0.69	0.50	0.34	0.23	0.26	0.46	0.77	0.94	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	621.32	689.52	723.91	661.84	517.07	343.76	227.82	238.73	373.89	542.61	587.96	593.85	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	941.75	914.55	830.01	684.90	519.83	343.92	227.83	238.75	375.07	580.86	774.69	933.95	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	238.40	151.22	78.94	16.60	2.05	0.00	0.00	0.00	0.00	28.46	134.44	253.04	

∑(98)1...5, 10...12 = 903.15 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 12.72 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	903.15		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	189.66	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	758.65	(307b)

Water heating

Annual water heating requirement	1766.16		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.89	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1483.57	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.03	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	108.28		(330a)
Total electricity for the above, kWh/year		108.28	(331)
Electricity for lighting (Appendix L)		314.29	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2992.16	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	189.66	x	2.97	x 0.01 =	5.63	(340a)
Space heating from boilers	758.65	x	4.24	x 0.01 =	32.17	(340b)
Water heating from CHP	370.89	x	2.97	x 0.01 =	11.02	(342a)
Water heating from boilers	1483.57	x	4.24	x 0.01 =	62.90	(342b)
Pumps and fans	108.28	x	13.19	x 0.01 =	14.28	(349)
Electricity for lighting	314.29	x	13.19	x 0.01 =	41.45	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		287.45	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.48	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	350.9403	x	0.2160	=	75.8031	(363)
less credit emissions for electricity		-116.3574	x	0.5190	=	-60.3895	(364)
Water heated by CHP		686.2783	x	0.2160	=	148.2361	(365)
less credit emissions for electricity		-227.5417	x	0.5190	=	-118.0941	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2302.08	x	0.216	=	497.25	(368)
Electrical energy for community heat distribution		28.03	x	0.519	=	14.55	(372)
Total CO2 associated with community systems						557.35	(373)
Total CO2 associated with space and water heating						557.35	(376)
Pumps and fans		108.28	x	0.519	=	56.19	(378)
Electricity for lighting		314.29	x	0.519	=	163.12	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	655.64	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.23	(384)
EI value					92.43	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	350.94	x	1.22	=	428.15	(363)
less credit energy for electricity		-116.36	x	3.07	=	-357.22	(364)
Water heated by CHP		686.28	x	1.22	=	837.26	(365)
less credit energy for electricity		-227.54	x	3.07	=	-698.55	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2302.08	x	1.22	=	2808.53	(368)
Electrical energy for community heat distribution		28.03	x	3.07	=	86.05	(372)
Total primary energy associated with community systems						3104.21	(373)
Total primary energy associated with space and water heating						3104.21	(376)
Pumps and fans		108.28	x	3.07	=	332.40	(378)
Electricity for lighting		314.29	x	3.07	=	964.86	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3685.63	(383)
Dwelling primary energy rate kWh/m2/year						51.91	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Mo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		71.00	(1a) x	2.50	(2a) =	177.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	71.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.60	x	1.24	=	20.51			(27)
External wall			14.40	x	0.15	=	2.16			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			31.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.67 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.65 (36)
Total fabric heat loss	(33) + (36) =	27.32 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.41	15.22	15.04	14.10	13.92	12.98	12.98	12.79	13.36	13.92	14.29	14.66	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.73	42.55	42.36	41.43	41.24	40.30	40.30	40.12	40.68	41.24	41.61	41.99	

Average = ∑(39)1...12/12 = 41.38 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.60	0.60	0.60	0.58	0.58	0.57	0.57	0.57	0.57	0.58	0.59	0.59	

Average = ∑(40)1...12/12 = 0.58 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.12 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.93	93.40	89.88	86.35	82.83	79.30	79.30	82.83	86.35	89.88	93.40	96.93	

∑(44)1...12 = 1057.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.74	125.72	129.73	113.10	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21	

∑(45)1...12 = 1386.41 (45)

Distribution loss 0.15 x (45)m

21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	

∑(64)1...12 = 1766.16 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.60	65.11	68.94	62.58	61.89	56.11	54.66	58.91	58.47	64.85	67.59	72.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.49	39.52	32.14	24.33	18.19	15.35	16.59	21.56	28.94	36.75	42.89	45.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.94	301.03	293.24	276.65	255.72	236.04	222.89	219.80	227.59	244.18	265.12	284.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)
Water heating gains (Table 5)	98.92	96.88	92.66	86.91	83.18	77.93	73.46	79.18	81.22	87.16	93.88	96.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.64	533.73	514.33	484.19	453.38	425.61	409.24	416.84	434.05	464.39	498.18	523.71	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	16.60	x	19.64	x 0.9 x	0.50	x	0.90	=	101.67	(76)

Solar gains in watts ∑(74)m...(82)m

101.67	198.89	327.55	477.71	585.45	599.31	570.57	490.11	380.95	236.00	126.77	83.61	(83)

Total gains - internal and solar (73)m + (83)m

639.32	732.62	841.87	961.90	1038.83	1024.93	979.81	906.95	815.00	700.39	624.96	607.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.86	0.72	0.52	0.37	0.25	0.18	0.20	0.34	0.61	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.83	20.92	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.81	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.43	20.43	20.43	20.44	20.45	20.46	20.46	20.46	20.45	20.45	20.44	20.44	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.93	0.85	0.69	0.50	0.35	0.23	0.16	0.18	0.32	0.58	0.84	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.22	20.34	20.42	20.44	20.45	20.46	20.46	20.46	20.45	20.44	20.37	20.20	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.45	20.56	20.63	20.65	20.65	20.66	20.66	20.66	20.66	20.65	20.59	20.43	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.45	20.56	20.63	20.65	20.65	20.66	20.66	20.66	20.66	20.65	20.59	20.43	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.93	0.85	0.70	0.51	0.36	0.24	0.17	0.19	0.33	0.59	0.84	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	593.07	622.55	589.46	486.30	369.27	244.34	163.74	171.06	266.82	412.99	527.69	572.05	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	690.17	666.27	598.49	486.85	369.29	244.35	163.74	171.06	266.83	414.53	561.24	681.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	72.24	29.38	6.72	0.39	0.02	0.00	0.00	0.00	0.00	1.15	24.15	81.40	

∑(98)1...5, 10...12 = 215.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.03 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11) — '0' if none = 0.00 (301)

Fraction of space heat from community system — 1 - (301) = 1.00 (302)

Fraction of community heat from boilers = 1.00 (303a)

Fraction of total space heat from community boilers — (302) x (303a) = 1.00 (304a)

Factor for control and charging method (Table 4c(3)) for community space heating = 1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating = 1.00 (305a)

Distribution loss factor (Table 12c) for community heating system = 1.05 (306)

Space heating

Annual space heating requirement: 215.45 (98)

Space heat from boilers — (98) x (304a) x (305) x (306) = 226.22 (307a)

Water heating

Annual water heating requirement: 1766.16 (64)

Water heat from boilers — (64) x (303a) x (305a) x (306) = 1854.46 (310a)

Electricity used for heat distribution — 0.01 × [(307a)...(307e) + (310a)...(310e)] = 20.81 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside: 108.28 (330a)

Total electricity for the above, kWh/year = 108.28 (331)

Electricity for lighting (Appendix L) = 314.29 (332)

Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2503.25	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	226.22	x	4.24	x 0.01 =	9.59	(340a)
Water heating from boilers	1854.46	x	4.24	x 0.01 =	78.63	(342a)
Pumps and fans	108.28	x	13.19	x 0.01 =	14.28	(349)
Electricity for lighting	314.29	x	13.19	x 0.01 =	41.45	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		263.96	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.67	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2136.23	x	0.216	=	461.43	(367)
Electrical energy for community heat distribution	20.81	x	0.519	=	10.80	(372)
Total CO2 associated with community systems					472.22	(373)
Total CO2 associated with space and water heating					472.22	(376)
Pumps and fans	108.28	x	0.519	=	56.19	(378)
Electricity for lighting	314.29	x	0.519	=	163.12	(379)
Total CO_2, kg/year				(376)..(382) =	691.53	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.74	(384)
EI value					92.01	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2136.23	x	1.22	=	2606.20	(367)
Electrical energy for community heat distribution	20.81	x	3.07	=	63.88	(372)
Total primary energy associated with community systems					2670.08	(373)
Total primary energy associated with space and water heating					2670.08	(376)
Pumps and fans	108.28	x	3.07	=	332.40	(378)
Electricity for lighting	314.29	x	3.07	=	964.86	(379)
Primary energy kWh/year					3967.34	(383)
Dwelling primary energy rate kWh/m2/year					55.88	(384)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Mo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		71.00	(1a) x	2.50	(2a) =	177.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	71.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.60	x	1.24	=	20.51			(27)
External wall			14.40	x	0.15	=	2.16			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			31.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.67 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.65 (36)
Total fabric heat loss	(33) + (36) =	27.32 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.41	15.22	15.04	14.10	13.92	12.98	12.98	12.79	13.36	13.92	14.29	14.66	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.73	42.55	42.36	41.43	41.24	40.30	40.30	40.12	40.68	41.24	41.61	41.99	

Average = ∑(39)1...12/12 = 41.38 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.60	0.60	0.60	0.58	0.58	0.57	0.57	0.57	0.57	0.58	0.59	0.59	

Average = ∑(40)1...12/12 = 0.58 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.12 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.93	93.40	89.88	86.35	82.83	79.30	79.30	82.83	86.35	89.88	93.40	96.93	

∑(44)1...12 = 1057.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.74	125.72	129.73	113.10	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21	

∑(45)1...12 = 1386.41 (45)

Distribution loss 0.15 x (45)m

21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	

∑(64)1...12 = 1766.16 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.60	65.11	68.94	62.58	61.89	56.11	54.66	58.91	58.47	64.85	67.59	72.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.49	39.52	32.14	24.33	18.19	15.35	16.59	21.56	28.94	36.75	42.89	45.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.94	301.03	293.24	276.65	255.72	236.04	222.89	219.80	227.59	244.18	265.12	284.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)
Water heating gains (Table 5)	98.92	96.88	92.66	86.91	83.18	77.93	73.46	79.18	81.22	87.16	93.88	96.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.64	533.73	514.33	484.19	453.38	425.61	409.24	416.84	434.05	464.39	498.18	523.71	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	16.60	x	19.64	x 0.9 x	0.50	x	0.90	=	101.67	(76)

Solar gains in watts ∑(74)m...(82)m

101.67	198.89	327.55	477.71	585.45	599.31	570.57	490.11	380.95	236.00	126.77	83.61	(83)

Total gains - internal and solar (73)m + (83)m

639.32	732.62	841.87	961.90	1038.83	1024.93	979.81	906.95	815.00	700.39	624.96	607.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.86	0.72	0.52	0.37	0.25	0.18	0.20	0.34	0.61	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.83	20.92	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.81	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.43	20.43	20.43	20.44	20.45	20.46	20.46	20.46	20.45	20.45	20.44	20.44	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.93	0.85	0.69	0.50	0.35	0.23	0.16	0.18	0.32	0.58	0.84	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.22	20.34	20.42	20.44	20.45	20.46	20.46	20.46	20.45	20.44	20.37	20.20	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.45	20.56	20.63	20.65	20.65	20.66	20.66	20.66	20.66	20.65	20.59	20.43	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.45	20.56	20.63	20.65	20.65	20.66	20.66	20.66	20.66	20.65	20.59	20.43	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.93	0.85	0.70	0.51	0.36	0.24	0.17	0.19	0.33	0.59	0.84	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	593.07	622.55	589.46	486.30	369.27	244.34	163.74	171.06	266.82	412.99	527.69	572.05	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	690.17	666.27	598.49	486.85	369.29	244.35	163.74	171.06	266.83	414.53	561.24	681.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	72.24	29.38	6.72	0.39	0.02	0.00	0.00	0.00	0.00	1.15	24.15	81.40	

∑(98)1...5, 10...12 = 215.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.03 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		0.80 (303a)
Fraction of community heat from CHP		0.20 (303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20 (304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	215.45		(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	45.24 (307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	180.98 (307b)

Water heating

Annual water heating requirement	1766.16		(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	370.89 (310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) =	1483.57 (310b)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.81 (313)

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Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	108.28		(330a)
Total electricity for the above, kWh/year		108.28	(331)
Electricity for lighting (Appendix L)		314.29	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2503.25	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	45.24	x	2.97	x 0.01 =	1.34	(340a)
Space heating from boilers	180.98	x	4.24	x 0.01 =	7.67	(340b)
Water heating from CHP	370.89	x	2.97	x 0.01 =	11.02	(342a)
Water heating from boilers	1483.57	x	4.24	x 0.01 =	62.90	(342b)
Pumps and fans	108.28	x	13.19	x 0.01 =	14.28	(349)
Electricity for lighting	314.29	x	13.19	x 0.01 =	41.45	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		258.67	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.94	(357)
SAP value	86.93	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	83.7180	x	0.2160	=	18.0831	(363)
less credit emissions for electricity		-27.7574	x	0.5190	=	-14.4061	(364)
Water heated by CHP		686.2783	x	0.2160	=	148.2361	(365)
less credit emissions for electricity		-227.5417	x	0.5190	=	-118.0941	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1708.98	x	0.216	=	369.14	(368)
Electrical energy for community heat distribution		20.81	x	0.519	=	10.80	(372)
Total CO2 associated with community systems						413.76	(373)
Total CO2 associated with space and water heating						413.76	(376)
Pumps and fans		108.28	x	0.519	=	56.19	(378)
Electricity for lighting		314.29	x	0.519	=	163.12	(379)
Total CO_2, kg/year					(376)..(382) =	633.07	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	8.92	(384)
EI value						92.69	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	83.72	x	1.22	=	102.14	(363)
less credit energy for electricity		-27.76	x	3.07	=	-85.22	(364)
Water heated by CHP		686.28	x	1.22	=	837.26	(365)
less credit energy for electricity		-227.54	x	3.07	=	-698.55	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1708.98	x	1.22	=	2084.96	(368)
Electrical energy for community heat distribution		20.81	x	3.07	=	63.88	(372)
Total primary energy associated with community systems						2304.46	(373)
Total primary energy associated with space and water heating						2304.46	(376)
Pumps and fans		108.28	x	3.07	=	332.40	(378)
Electricity for lighting		314.29	x	3.07	=	964.86	(379)
Primary energy kWh/year						3601.73	(383)
Dwelling primary energy rate kWh/m2/year						50.73	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Mo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		71.00	(1a) x	2.50	(2a) =	177.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	71.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.60	x	1.24	=	20.51			(27)
External wall			14.40	x	0.15	=	2.16			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			31.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.67 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.65 (36)
Total fabric heat loss	(33) + (36) =	27.32 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.41	15.22	15.04	14.10	13.92	12.98	12.98	12.79	13.36	13.92	14.29	14.66	(38)

Heat transfer coefficient, W/K (37)m + (38)m

42.73	42.55	42.36	41.43	41.24	40.30	40.30	40.12	40.68	41.24	41.61	41.99	

Average = ∑(39)1...12/12 = 41.38 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.60	0.60	0.60	0.58	0.58	0.57	0.57	0.57	0.57	0.58	0.59	0.59	

Average = ∑(40)1...12/12 = 0.58 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.12 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.93	93.40	89.88	86.35	82.83	79.30	79.30	82.83	86.35	89.88	93.40	96.93	

∑(44)1...12 = 1057.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.74	125.72	129.73	113.10	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21	

∑(45)1...12 = 1386.41 (45)

Distribution loss 0.15 x (45)m

21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	

∑(64)1...12 = 1766.16 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.60	65.11	68.94	62.58	61.89	56.11	54.66	58.91	58.47	64.85	67.59	72.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.49	39.52	32.14	24.33	18.19	15.35	16.59	21.56	28.94	36.75	42.89	45.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.94	301.03	293.24	276.65	255.72	236.04	222.89	219.80	227.59	244.18	265.12	284.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)
Water heating gains (Table 5)	98.92	96.88	92.66	86.91	83.18	77.93	73.46	79.18	81.22	87.16	93.88	96.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.64	533.73	514.33	484.19	453.38	425.61	409.24	416.84	434.05	464.39	498.18	523.71	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	16.60	x	19.64	x 0.9 x	0.50	x	0.90	=	101.67	(76)

Solar gains in watts ∑(74)m...(82)m

101.67	198.89	327.55	477.71	585.45	599.31	570.57	490.11	380.95	236.00	126.77	83.61	(83)

Total gains - internal and solar (73)m + (83)m

639.32	732.62	841.87	961.90	1038.83	1024.93	979.81	906.95	815.00	700.39	624.96	607.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.94	0.86	0.72	0.52	0.37	0.25	0.18	0.20	0.34	0.61	0.86	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.83	20.92	20.98	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.94	20.81	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.43	20.43	20.43	20.44	20.45	20.46	20.46	20.46	20.45	20.45	20.44	20.44	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.93	0.85	0.69	0.50	0.35	0.23	0.16	0.18	0.32	0.58	0.84	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.22	20.34	20.42	20.44	20.45	20.46	20.46	20.46	20.45	20.44	20.37	20.20	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.45	20.56	20.63	20.65	20.65	20.66	20.66	20.66	20.66	20.65	20.59	20.43	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.45	20.56	20.63	20.65	20.65	20.66	20.66	20.66	20.66	20.65	20.59	20.43	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.93	0.85	0.70	0.51	0.36	0.24	0.17	0.19	0.33	0.59	0.84	0.94	(94)
Useful gains, ηmGm, W (94)m x (84)m	593.07	622.55	589.46	486.30	369.27	244.34	163.74	171.06	266.82	412.99	527.69	572.05	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	690.17	666.27	598.49	486.85	369.29	244.35	163.74	171.06	266.83	414.53	561.24	681.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	72.24	29.38	6.72	0.39	0.02	0.00	0.00	0.00	0.00	1.15	24.15	81.40	

∑(98)1...5, 10...12 = 215.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 3.03 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	215.45		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	45.24	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	180.98	(307b)

Water heating

Annual water heating requirement	1766.16		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.89	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1483.57	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.81	(313)

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Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	108.28		(330a)
Total electricity for the above, kWh/year		108.28	(331)
Electricity for lighting (Appendix L)		314.29	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2270.07	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	45.24	x	2.97	x 0.01 =	1.34	(340a)
Space heating from boilers	180.98	x	4.24	x 0.01 =	7.67	(340b)
Water heating from CHP	370.89	x	2.97	x 0.01 =	11.02	(342a)
Water heating from boilers	1483.57	x	4.24	x 0.01 =	62.90	(342b)
Pumps and fans	108.28	x	13.19	x 0.01 =	14.28	(349)
Electricity for lighting	314.29	x	13.19	x 0.01 =	41.45	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		258.67	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.94	(357)
SAP value	86.93	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	83.7180	x	0.2160	=	18.0831	(363)
less credit emissions for electricity		-27.7574	x	0.5190	=	-14.4061	(364)
Water heated by CHP		686.2783	x	0.2160	=	148.2361	(365)
less credit emissions for electricity		-227.5417	x	0.5190	=	-118.0941	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1708.98	x	0.216	=	369.14	(368)
Electrical energy for community heat distribution		20.81	x	0.519	=	10.80	(372)
Total CO2 associated with community systems						413.76	(373)
Total CO2 associated with space and water heating						413.76	(376)
Pumps and fans		108.28	x	0.519	=	56.19	(378)
Electricity for lighting		314.29	x	0.519	=	163.12	(379)
Energy saving/generation technologies							
pv savings		-233.18	x	0.519	=	-121.02	(380)

Total CO_2, kg/year	(376)..(382) =	512.05	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	7.21	(384)
EI value		94.08	
EI rating (section 14)		94	(385)
EI band		A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	83.72	x	1.22	=	102.14	(363)
less credit energy for electricity		-27.76	x	3.07	=	-85.22	(364)
Water heated by CHP		686.28	x	1.22	=	837.26	(365)
less credit energy for electricity		-227.54	x	3.07	=	-698.55	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1708.98	x	1.22	=	2084.96	(368)
Electrical energy for community heat distribution		20.81	x	3.07	=	63.88	(372)
Total primary energy associated with community systems						2304.46	(373)
Total primary energy associated with space and water heating						2304.46	(376)
Pumps and fans		108.28	x	3.07	=	332.40	(378)
Electricity for lighting		314.29	x	3.07	=	964.86	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2885.88	(383)
Dwelling primary energy rate kWh/m2/year						40.65	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Mr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		71.00	(1a) x	2.50	(2a) =	177.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	71.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.60	x	1.24	=	20.51			(27)
External wall			14.40	x	0.15	=	2.16			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Roof			18.00	x	0.12	=	2.16			(30)
Total area of external elements ∑A, m²			49.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.83 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.35 (36)
Total fabric heat loss	(33) + (36) =	32.18 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.41	15.22	15.04	14.10	13.92	12.98	12.98	12.79	13.36	13.92	14.29	14.66	(38)

Heat transfer coefficient, W/K (37)m + (38)m

47.59	47.41	47.22	46.29	46.10	45.16	45.16	44.98	45.54	46.10	46.47	46.85	

Average = ∑(39)1...12/12 = 46.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.67	0.67	0.67	0.65	0.65	0.64	0.64	0.63	0.64	0.65	0.65	0.66	

Average = ∑(40)1...12/12 = 0.65 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.12 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.93	93.40	89.88	86.35	82.83	79.30	79.30	82.83	86.35	89.88	93.40	96.93	

∑(44)1...12 = 1057.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.74	125.72	129.73	113.10	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21	

∑(45)1...12 = 1386.41 (45)

Distribution loss 0.15 x (45)m

21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	

∑(64)1...12 = 1766.16 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.60	65.11	68.94	62.58	61.89	56.11	54.66	58.91	58.47	64.85	67.59	72.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.49	39.52	32.14	24.33	18.19	15.35	16.59	21.56	28.94	36.75	42.89	45.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.94	301.03	293.24	276.65	255.72	236.04	222.89	219.80	227.59	244.18	265.12	284.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)
Water heating gains (Table 5)	98.92	96.88	92.66	86.91	83.18	77.93	73.46	79.18	81.22	87.16	93.88	96.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.64	533.73	514.33	484.19	453.38	425.61	409.24	416.84	434.05	464.39	498.18	523.71	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	16.60	x	19.64	x 0.9 x	0.50	x	0.90	=	101.67	(76)

Solar gains in watts ∑(74)m...(82)m

101.67	198.89	327.55	477.71	585.45	599.31	570.57	490.11	380.95	236.00	126.77	83.61	(83)

Total gains - internal and solar (73)m + (83)m

639.32	732.62	841.87	961.90	1038.83	1024.93	979.81	906.95	815.00	700.39	624.96	607.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.91	0.78	0.58	0.41	0.28	0.20	0.23	0.39	0.67	0.90	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.74	20.86	20.96	21.00	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.71	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.37	20.37	20.37	20.38	20.39	20.40	20.40	20.40	20.39	20.39	20.38	20.38	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.95	0.89	0.75	0.55	0.39	0.26	0.18	0.20	0.35	0.64	0.88	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.03	20.19	20.32	20.38	20.39	20.40	20.40	20.40	20.39	20.38	20.24	20.01	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.30	20.44	20.56	20.61	20.62	20.62	20.62	20.63	20.62	20.61	20.48	20.27	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.30	20.44	20.56	20.61	20.62	20.62	20.62	20.63	20.62	20.61	20.48	20.27	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.89	0.76	0.56	0.40	0.27	0.19	0.21	0.36	0.65	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	606.69	652.46	639.95	539.76	410.90	272.07	181.74	190.05	296.91	455.89	554.73	582.81	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	761.36	736.81	664.02	542.04	411.03	272.07	181.74	190.05	296.95	461.29	621.96	752.85	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	115.08	56.68	17.91	1.64	0.10	0.00	0.00	0.00	0.00	4.02	48.40	126.51	

∑(98)1...5, 10...12 = 370.35 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.22 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	370.35		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	388.87	(307a)

Water heating

Annual water heating requirement	1766.16		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1854.46	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	22.43	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	108.28		(330a)
Total electricity for the above, kWh/year		108.28	(331)

Electricity for lighting (Appendix L)		314.29	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2665.90	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	388.87	x	4.24	x 0.01 =	16.49	(340a)
Water heating from boilers	1854.46	x	4.24	x 0.01 =	78.63	(342a)
Pumps and fans	108.28	x	13.19	x 0.01 =	14.28	(349)
Electricity for lighting	314.29	x	13.19	x 0.01 =	41.45	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		270.85	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.98	(357)
SAP value	86.32	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2303.22	x	0.216	=	497.49	(367)
Electrical energy for community heat distribution	22.43	x	0.519	=	11.64	(372)
Total CO2 associated with community systems					509.14	(373)
Total CO2 associated with space and water heating					509.14	(376)
Pumps and fans	108.28	x	0.519	=	56.19	(378)
Electricity for lighting	314.29	x	0.519	=	163.12	(379)
Total CO_2, kg/year				(376)..(382) =	728.45	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.26	(384)
EI value					91.59	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2303.22	x	1.22	=	2809.92	(367)
Electrical energy for community heat distribution	22.43	x	3.07	=	68.87	(372)
Total primary energy associated with community systems					2878.80	(373)
Total primary energy associated with space and water heating					2878.80	(376)
Pumps and fans	108.28	x	3.07	=	332.40	(378)
Electricity for lighting	314.29	x	3.07	=	964.86	(379)
Primary energy kWh/year					4176.06	(383)
Dwelling primary energy rate kWh/m2/year					58.82	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Mr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		71.00	(1a) x	2.50	(2a) =	177.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	71.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	177.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.60	x	1.24	=	20.51			(27)
External wall			14.40	x	0.15	=	2.16			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Roof			18.00	x	0.12	=	2.16			(30)
Total area of external elements ∑A, m²			49.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.83 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.35 (36)
Total fabric heat loss	(33) + (36) =	32.18 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.41	15.22	15.04	14.10	13.92	12.98	12.98	12.79	13.36	13.92	14.29	14.66	(38)

Heat transfer coefficient, W/K (37)m + (38)m

47.59	47.41	47.22	46.29	46.10	45.16	45.16	44.98	45.54	46.10	46.47	46.85	

Average = ∑(39)1...12/12 = 46.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.67	0.67	0.67	0.65	0.65	0.64	0.64	0.63	0.64	0.65	0.65	0.66	

Average = ∑(40)1...12/12 = 0.65 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.27 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.12 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.93	93.40	89.88	86.35	82.83	79.30	79.30	82.83	86.35	89.88	93.40	96.93	

∑(44)1...12 = 1057.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.74	125.72	129.73	113.10	108.52	93.65	86.78	99.58	100.77	117.44	128.19	139.21	

∑(45)1...12 = 1386.41 (45)

Distribution loss 0.15 x (45)m

21.56	18.86	19.46	16.97	16.28	14.05	13.02	14.94	15.12	17.62	19.23	20.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.99	154.85	161.98	144.31	140.78	124.86	119.03	131.83	131.98	149.69	159.40	171.46	

∑(64)1...12 = 1766.16 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.60	65.11	68.94	62.58	61.89	56.11	54.66	58.91	58.47	64.85	67.59	72.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	136.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.49	39.52	32.14	24.33	18.19	15.35	16.59	21.56	28.94	36.75	42.89	45.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.94	301.03	293.24	276.65	255.72	236.04	222.89	219.80	227.59	244.18	265.12	284.79	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	-90.81	(71)
Water heating gains (Table 5)	98.92	96.88	92.66	86.91	83.18	77.93	73.46	79.18	81.22	87.16	93.88	96.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	537.64	533.73	514.33	484.19	453.38	425.61	409.24	416.84	434.05	464.39	498.18	523.71	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	16.60	x	19.64	x 0.9 x	0.50	x	0.90	=	101.67	(76)

Solar gains in watts ∑(74)m...(82)m

101.67	198.89	327.55	477.71	585.45	599.31	570.57	490.11	380.95	236.00	126.77	83.61	(83)

Total gains - internal and solar (73)m + (83)m

639.32	732.62	841.87	961.90	1038.83	1024.93	979.81	906.95	815.00	700.39	624.96	607.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.91	0.78	0.58	0.41	0.28	0.20	0.23	0.39	0.67	0.90	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.74	20.86	20.96	21.00	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.71	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.37	20.37	20.37	20.38	20.39	20.40	20.40	20.40	20.39	20.39	20.38	20.38	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.95	0.89	0.75	0.55	0.39	0.26	0.18	0.20	0.35	0.64	0.88	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.03	20.19	20.32	20.38	20.39	20.40	20.40	20.40	20.39	20.38	20.24	20.01	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.30	20.44	20.56	20.61	20.62	20.62	20.62	20.63	20.62	20.61	20.48	20.27	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.30	20.44	20.56	20.61	20.62	20.62	20.62	20.63	20.62	20.61	20.48	20.27	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.89	0.76	0.56	0.40	0.27	0.19	0.21	0.36	0.65	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	606.69	652.46	639.95	539.76	410.90	272.07	181.74	190.05	296.91	455.89	554.73	582.81	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	761.36	736.81	664.02	542.04	411.03	272.07	181.74	190.05	296.95	461.29	621.96	752.85	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	115.08	56.68	17.91	1.64	0.10	0.00	0.00	0.00	0.00	4.02	48.40	126.51	

∑(98)1...5, 10...12 = 370.35 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.22 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	370.35		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	77.77	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	311.10	(307b)

Water heating

Annual water heating requirement	1766.16		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.89	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1483.57	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	22.43	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	108.28		(330a)
Total electricity for the above, kWh/year		108.28	(331)
Electricity for lighting (Appendix L)		314.29	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2665.90	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	77.77	x	2.97	x 0.01 =	2.31	(340a)
Space heating from boilers	311.10	x	4.24	x 0.01 =	13.19	(340b)
Water heating from CHP	370.89	x	2.97	x 0.01 =	11.02	(342a)
Water heating from boilers	1483.57	x	4.24	x 0.01 =	62.90	(342b)
Pumps and fans	108.28	x	13.19	x 0.01 =	14.28	(349)
Electricity for lighting	314.29	x	13.19	x 0.01 =	41.45	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		265.16	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.61	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	143.9079	x	0.2160	=	31.0841	(363)
less credit emissions for electricity		-47.7140	x	0.5190	=	-24.7635	(364)
Water heated by CHP		686.2783	x	0.2160	=	148.2361	(365)
less credit emissions for electricity		-227.5417	x	0.5190	=	-118.0941	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1842.57	x	0.216	=	398.00	(368)
Electrical energy for community heat distribution		22.43	x	0.519	=	11.64	(372)
Total CO2 associated with community systems						446.10	(373)
Total CO2 associated with space and water heating						446.10	(376)
Pumps and fans		108.28	x	0.519	=	56.19	(378)
Electricity for lighting		314.29	x	0.519	=	163.12	(379)
Total CO_2, kg/year					(376)..(382) =	665.41	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.37	(384)
EI value						92.31	
EI rating (section 14)						92	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	143.91	x	1.22	=	175.57	(363)
less credit energy for electricity		-47.71	x	3.07	=	-146.48	(364)
Water heated by CHP		686.28	x	1.22	=	837.26	(365)
less credit energy for electricity		-227.54	x	3.07	=	-698.55	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1842.57	x	1.22	=	2247.94	(368)
Electrical energy for community heat distribution		22.43	x	3.07	=	68.87	(372)
Total primary energy associated with community systems						2484.60	(373)
Total primary energy associated with space and water heating						2484.60	(376)
Pumps and fans		108.28	x	3.07	=	332.40	(378)
Electricity for lighting		314.29	x	3.07	=	964.86	(379)
Primary energy kWh/year						3781.87	(383)
Dwelling primary energy rate kWh/m2/year						53.27	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Nf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		62.20	(1a) x	2.50	(2a) =	155.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	62.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	155.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.66	x	1.24	=	16.88			(27)
Exposed floor			62.20	x	0.19	=	11.76			(28b
External wall			13.84	x	0.15	=	2.08			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			89.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.71 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.46 (36)
Total fabric heat loss	(33) + (36) =	44.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.50	13.34	13.17	12.35	12.19	11.37	11.37	11.21	11.70	12.19	12.52	12.84	(38)

Heat transfer coefficient, W/K (37)m + (38)m

57.67	57.50	57.34	56.52	56.36	55.54	55.54	55.38	55.87	56.36	56.68	57.01	

Average = ∑(39)1...12/12 = 56.48 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.93	0.92	0.92	0.91	0.91	0.89	0.89	0.89	0.90	0.91	0.91	0.92	

Average = ∑(40)1...12/12 = 0.91 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.04 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		82.72 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
91.00	87.69	84.38	81.07	77.76	74.45	74.45	77.76	81.07	84.38	87.69	91.00	

∑(44)1...12 = 992.68 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

134.94	118.02	121.79	106.18	101.88	87.92	81.47	93.48	94.60	110.25	120.34	130.69	

∑(45)1...12 = 1301.57 (45)

Distribution loss 0.15 x (45)m

20.24	17.70	18.27	15.93	15.28	13.19	12.22	14.02	14.19	16.54	18.05	19.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	

∑(64)1...12 = 1681.31 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.67	62.55	66.30	60.27	59.68	54.20	52.89	56.89	56.42	62.46	64.98	69.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.77	35.33	28.73	21.75	16.26	13.73	14.83	19.28	25.88	32.86	38.35	40.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.36	269.12	262.16	247.33	228.61	211.02	199.27	196.50	203.47	218.30	237.01	254.60	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	(71)
Water heating gains (Table 5)	94.99	93.08	89.11	83.71	80.21	75.28	71.09	76.46	78.37	83.95	90.26	93.08	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	491.28	487.69	470.16	442.96	415.25	390.19	375.35	382.40	397.88	425.27	455.78	478.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	13.66	x	19.64	x 0.9 x	0.50	x	0.90	=	83.66	(76)

Solar gains in watts ∑(74)m...(82)m

83.66	163.67	269.54	393.10	481.76	493.17	469.52	403.31	313.48	194.20	104.32	68.80	(83)

Total gains - internal and solar (73)m + (83)m

574.95	651.36	739.69	836.06	897.01	883.36	844.87	785.71	711.36	619.47	560.10	547.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.76	0.57	0.40	0.29	0.32	0.54	0.83	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.37	20.53	20.74	20.92	20.99	21.00	21.00	21.00	20.99	20.89	20.61	20.34	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.14	20.15	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.95	0.88	0.72	0.53	0.35	0.23	0.27	0.47	0.79	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.33	19.55	19.85	20.08	20.15	20.17	20.17	20.18	20.16	20.05	19.67	19.29	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.73	19.93	20.19	20.41	20.47	20.49	20.49	20.49	20.48	20.37	20.03	19.70	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.73	19.93	20.19	20.41	20.47	20.49	20.49	20.49	20.48	20.37	20.03	19.70	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.88	0.73	0.54	0.37	0.26	0.29	0.50	0.80	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	559.37	617.31	652.25	612.77	488.50	326.73	216.10	226.57	354.08	498.25	529.88	535.61	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	889.92	864.16	785.02	650.34	494.42	327.17	216.14	226.65	356.64	550.89	733.08	883.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	245.92	165.88	98.78	27.05	4.40	0.00	0.00	0.00	0.00	39.16	146.31	258.81	

∑(98)1...5, 10...12 = 986.31 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 15.86 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	986.31		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1035.63	(307a)

Water heating

Annual water heating requirement	1681.31		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1765.38	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.01	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	94.86		(330a)
Total electricity for the above, kWh/year		94.86	(331)

Electricity for lighting (Appendix L)		280.97	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3176.83	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1035.63	x	4.24	x 0.01 =	43.91	(340a)
Water heating from boilers	1765.38	x	4.24	x 0.01 =	74.85	(342a)
Pumps and fans	94.86	x	13.19	x 0.01 =	12.51	(349)
Electricity for lighting	280.97	x	13.19	x 0.01 =	37.06	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		288.33	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.24	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2875.78	x	0.216	=	621.17	(367)
Electrical energy for community heat distribution	28.01	x	0.519	=	14.54	(372)
Total CO2 associated with community systems					635.71	(373)
Total CO2 associated with space and water heating					635.71	(376)
Pumps and fans	94.86	x	0.519	=	49.23	(378)
Electricity for lighting	280.97	x	0.519	=	145.82	(379)
Total CO_2, kg/year				(376)..(382) =	830.76	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.36	(384)
EI value					89.62	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2875.78	x	1.22	=	3508.45	(367)
Electrical energy for community heat distribution	28.01	x	3.07	=	85.99	(372)
Total primary energy associated with community systems					3594.44	(373)
Total primary energy associated with space and water heating					3594.44	(376)
Pumps and fans	94.86	x	3.07	=	291.20	(378)
Electricity for lighting	280.97	x	3.07	=	862.58	(379)
Primary energy kWh/year					4748.23	(383)
Dwelling primary energy rate kWh/m2/year					76.34	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Nf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		62.20	(1a) x	2.50	(2a) =	155.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	62.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	155.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.66	x	1.24	=	16.88			(27)
Exposed floor			62.20	x	0.19	=	11.76			(28b
External wall			13.84	x	0.15	=	2.08			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			89.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.71 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.46 (36)
Total fabric heat loss	(33) + (36) =	44.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.50	13.34	13.17	12.35	12.19	11.37	11.37	11.21	11.70	12.19	12.52	12.84	(38)

Heat transfer coefficient, W/K (37)m + (38)m

57.67	57.50	57.34	56.52	56.36	55.54	55.54	55.38	55.87	56.36	56.68	57.01	

Average = ∑(39)1...12/12 = 56.48 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.93	0.92	0.92	0.91	0.91	0.89	0.89	0.89	0.90	0.91	0.91	0.92	

Average = ∑(40)1...12/12 = 0.91 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.04 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		82.72 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
91.00	87.69	84.38	81.07	77.76	74.45	74.45	77.76	81.07	84.38	87.69	91.00	

∑(44)1...12 = 992.68 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

134.94	118.02	121.79	106.18	101.88	87.92	81.47	93.48	94.60	110.25	120.34	130.69	

∑(45)1...12 = 1301.57 (45)

Distribution loss 0.15 x (45)m

20.24	17.70	18.27	15.93	15.28	13.19	12.22	14.02	14.19	16.54	18.05	19.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	

∑(64)1...12 = 1681.31 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.67	62.55	66.30	60.27	59.68	54.20	52.89	56.89	56.42	62.46	64.98	69.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.77	35.33	28.73	21.75	16.26	13.73	14.83	19.28	25.88	32.86	38.35	40.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.36	269.12	262.16	247.33	228.61	211.02	199.27	196.50	203.47	218.30	237.01	254.60	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	(71)
Water heating gains (Table 5)	94.99	93.08	89.11	83.71	80.21	75.28	71.09	76.46	78.37	83.95	90.26	93.08	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	491.28	487.69	470.16	442.96	415.25	390.19	375.35	382.40	397.88	425.27	455.78	478.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	13.66	x	19.64	x 0.9 x	0.50	x	0.90	=	83.66	(76)

Solar gains in watts ∑(74)m...(82)m

83.66	163.67	269.54	393.10	481.76	493.17	469.52	403.31	313.48	194.20	104.32	68.80	(83)

Total gains - internal and solar (73)m + (83)m

574.95	651.36	739.69	836.06	897.01	883.36	844.87	785.71	711.36	619.47	560.10	547.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.76	0.57	0.40	0.29	0.32	0.54	0.83	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.37	20.53	20.74	20.92	20.99	21.00	21.00	21.00	20.99	20.89	20.61	20.34	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.14	20.15	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.95	0.88	0.72	0.53	0.35	0.23	0.27	0.47	0.79	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.33	19.55	19.85	20.08	20.15	20.17	20.17	20.18	20.16	20.05	19.67	19.29	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.73	19.93	20.19	20.41	20.47	20.49	20.49	20.49	20.48	20.37	20.03	19.70	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.73	19.93	20.19	20.41	20.47	20.49	20.49	20.49	20.48	20.37	20.03	19.70	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.88	0.73	0.54	0.37	0.26	0.29	0.50	0.80	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	559.37	617.31	652.25	612.77	488.50	326.73	216.10	226.57	354.08	498.25	529.88	535.61	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	889.92	864.16	785.02	650.34	494.42	327.17	216.14	226.65	356.64	550.89	733.08	883.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	245.92	165.88	98.78	27.05	4.40	0.00	0.00	0.00	0.00	39.16	146.31	258.81	

∑(98)1...5, 10...12 = 986.31 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 15.86 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	986.31		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	207.13	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	828.50	(307b)

Water heating

Annual water heating requirement	1681.31		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	353.08	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1412.30	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.01	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	94.86		(330a)
Total electricity for the above, kWh/year		94.86	(331)
Electricity for lighting (Appendix L)		280.97	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3176.83	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	207.13	x	2.97	x 0.01 =	6.15	(340a)
Space heating from boilers	828.50	x	4.24	x 0.01 =	35.13	(340b)
Water heating from CHP	353.08	x	2.97	x 0.01 =	10.49	(342a)
Water heating from boilers	1412.30	x	4.24	x 0.01 =	59.88	(342b)
Pumps and fans	94.86	x	13.19	x 0.01 =	12.51	(349)
Electricity for lighting	280.97	x	13.19	x 0.01 =	37.06	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		281.22	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.63	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	383.2536	x	0.2160	=	82.7828	(363)
less credit emissions for electricity		-127.0711	x	0.5190	=	-65.9499	(364)
Water heated by CHP		653.3101	x	0.2160	=	141.1150	(365)
less credit emissions for electricity		-216.6108	x	0.5190	=	-112.4210	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2300.62	x	0.216	=	496.93	(368)
Electrical energy for community heat distribution		28.01	x	0.519	=	14.54	(372)
Total CO2 associated with community systems						557.00	(373)
Total CO2 associated with space and water heating						557.00	(376)
Pumps and fans		94.86	x	0.519	=	49.23	(378)
Electricity for lighting		280.97	x	0.519	=	145.82	(379)
Total CO_2, kg/year					(376)..(382) =	752.05	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.09	(384)
EI value						90.60	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	383.25	x	1.22	=	467.57	(363)
less credit energy for electricity		-127.07	x	3.07	=	-390.11	(364)
Water heated by CHP		653.31	x	1.22	=	797.04	(365)
less credit energy for electricity		-216.61	x	3.07	=	-665.00	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2300.62	x	1.22	=	2806.76	(368)
Electrical energy for community heat distribution		28.01	x	3.07	=	85.99	(372)
Total primary energy associated with community systems						3102.25	(373)
Total primary energy associated with space and water heating						3102.25	(376)
Pumps and fans		94.86	x	3.07	=	291.20	(378)
Electricity for lighting		280.97	x	3.07	=	862.58	(379)
Primary energy kWh/year						4256.04	(383)
Dwelling primary energy rate kWh/m2/year						68.43	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Nf 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		62.20	(1a) x	2.50	(2a) =	155.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	62.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	155.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.66	x	1.24	=	16.88			(27)
Exposed floor			62.20	x	0.19	=	11.76			(28b
External wall			13.84	x	0.15	=	2.08			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			89.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.71 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.46 (36)
Total fabric heat loss	(33) + (36) =	44.17 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.50	13.34	13.17	12.35	12.19	11.37	11.37	11.21	11.70	12.19	12.52	12.84	(38)

Heat transfer coefficient, W/K (37)m + (38)m

57.67	57.50	57.34	56.52	56.36	55.54	55.54	55.38	55.87	56.36	56.68	57.01	

Average = ∑(39)1...12/12 = 56.48 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.93	0.92	0.92	0.91	0.91	0.89	0.89	0.89	0.90	0.91	0.91	0.92	

Average = ∑(40)1...12/12 = 0.91 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.04 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		82.72 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
91.00	87.69	84.38	81.07	77.76	74.45	74.45	77.76	81.07	84.38	87.69	91.00	

∑(44)1...12 = 992.68 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

134.94	118.02	121.79	106.18	101.88	87.92	81.47	93.48	94.60	110.25	120.34	130.69	

∑(45)1...12 = 1301.57 (45)

Distribution loss 0.15 x (45)m

20.24	17.70	18.27	15.93	15.28	13.19	12.22	14.02	14.19	16.54	18.05	19.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	

∑(64)1...12 = 1681.31 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.67	62.55	66.30	60.27	59.68	54.20	52.89	56.89	56.42	62.46	64.98	69.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.77	35.33	28.73	21.75	16.26	13.73	14.83	19.28	25.88	32.86	38.35	40.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.36	269.12	262.16	247.33	228.61	211.02	199.27	196.50	203.47	218.30	237.01	254.60	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	(71)
Water heating gains (Table 5)	94.99	93.08	89.11	83.71	80.21	75.28	71.09	76.46	78.37	83.95	90.26	93.08	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	491.28	487.69	470.16	442.96	415.25	390.19	375.35	382.40	397.88	425.27	455.78	478.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	13.66	x	19.64	x 0.9 x	0.50	x	0.90	=	83.66	(76)

Solar gains in watts ∑(74)m...(82)m

83.66	163.67	269.54	393.10	481.76	493.17	469.52	403.31	313.48	194.20	104.32	68.80	(83)

Total gains - internal and solar (73)m + (83)m

574.95	651.36	739.69	836.06	897.01	883.36	844.87	785.71	711.36	619.47	560.10	547.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.90	0.76	0.57	0.40	0.29	0.32	0.54	0.83	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.37	20.53	20.74	20.92	20.99	21.00	21.00	21.00	20.99	20.89	20.61	20.34	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.14	20.15	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.95	0.88	0.72	0.53	0.35	0.23	0.27	0.47	0.79	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.33	19.55	19.85	20.08	20.15	20.17	20.17	20.18	20.16	20.05	19.67	19.29	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.73	19.93	20.19	20.41	20.47	20.49	20.49	20.49	20.48	20.37	20.03	19.70	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.73	19.93	20.19	20.41	20.47	20.49	20.49	20.49	20.48	20.37	20.03	19.70	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.88	0.73	0.54	0.37	0.26	0.29	0.50	0.80	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	559.37	617.31	652.25	612.77	488.50	326.73	216.10	226.57	354.08	498.25	529.88	535.61	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	889.92	864.16	785.02	650.34	494.42	327.17	216.14	226.65	356.64	550.89	733.08	883.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	245.92	165.88	98.78	27.05	4.40	0.00	0.00	0.00	0.00	39.16	146.31	258.81	

∑(98)1...5, 10...12 = 986.31 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 15.86 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	986.31		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	207.13	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	828.50	(307b)

Water heating

Annual water heating requirement	1681.31		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	353.08	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1412.30	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.01	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	94.86		(330a)
Total electricity for the above, kWh/year		94.86	(331)
Electricity for lighting (Appendix L)		280.97	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2943.66	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	207.13	x	2.97	x 0.01 =	6.15	(340a)
Space heating from boilers	828.50	x	4.24	x 0.01 =	35.13	(340b)
Water heating from CHP	353.08	x	2.97	x 0.01 =	10.49	(342a)
Water heating from boilers	1412.30	x	4.24	x 0.01 =	59.88	(342b)
Pumps and fans	94.86	x	13.19	x 0.01 =	12.51	(349)
Electricity for lighting	280.97	x	13.19	x 0.01 =	37.06	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		281.22	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.63	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	383.2536	x	0.2160	=	82.7828	(363)
less credit emissions for electricity		-127.0711	x	0.5190	=	-65.9499	(364)
Water heated by CHP		653.3101	x	0.2160	=	141.1150	(365)
less credit emissions for electricity		-216.6108	x	0.5190	=	-112.4210	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2300.62	x	0.216	=	496.93	(368)
Electrical energy for community heat distribution		28.01	x	0.519	=	14.54	(372)
Total CO2 associated with community systems						557.00	(373)
Total CO2 associated with space and water heating						557.00	(376)
Pumps and fans		94.86	x	0.519	=	49.23	(378)
Electricity for lighting		280.97	x	0.519	=	145.82	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	631.03	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.15	(384)
EI value					92.11	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	383.25	x	1.22	=	467.57	(363)
less credit energy for electricity		-127.07	x	3.07	=	-390.11	(364)
Water heated by CHP		653.31	x	1.22	=	797.04	(365)
less credit energy for electricity		-216.61	x	3.07	=	-665.00	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2300.62	x	1.22	=	2806.76	(368)
Electrical energy for community heat distribution		28.01	x	3.07	=	85.99	(372)
Total primary energy associated with community systems						3102.25	(373)
Total primary energy associated with space and water heating						3102.25	(376)
Pumps and fans		94.86	x	3.07	=	291.20	(378)
Electricity for lighting		280.97	x	3.07	=	862.58	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3540.19	(383)
Dwelling primary energy rate kWh/m2/year						56.92	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	No 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		62.20	(1a) x	2.50	(2a) =	155.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	62.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	155.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.66	x	1.24	=	16.88			(27)
External wall			13.84	x	0.15	=	2.08			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			27.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.96 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.13 (36)
Total fabric heat loss	(33) + (36) =	23.08 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	13.50	13.34	13.17	12.35	12.19	11.37	11.37	11.21	11.70	12.19	12.52	12.84	(38)
Heat transfer coefficient, W/K (37)m + (38)m	36.58	36.42	36.25	35.44	35.27	34.45	34.45	34.29	34.78	35.27	35.60	35.93	

Average = ∑(39)1...12/12 = 35.39 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.59	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	

Average = ∑(40)1...12/12 = 0.57 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.04 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.72 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	91.00	87.69	84.38	81.07	77.76	74.45	74.45	77.76	81.07	84.38	87.69	91.00	

∑(44)1...12 = 992.68 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	134.94	118.02	121.79	106.18	101.88	87.92	81.47	93.48	94.60	110.25	120.34	130.69	

∑(45)1...12 = 1301.57 (45)

Distribution loss 0.15 x (45)m	20.24	17.70	18.27	15.93	15.28	13.19	12.22	14.02	14.19	16.54	18.05	19.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)
Primary circuit loss for each month from Table 3	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	

∑(64)1...12 = 1681.31 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.67	62.55	66.30	60.27	59.68	54.20	52.89	56.89	56.42	62.46	64.98	69.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.77	35.33	28.73	21.75	16.26	13.73	14.83	19.28	25.88	32.86	38.35	40.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.36	269.12	262.16	247.33	228.61	211.02	199.27	196.50	203.47	218.30	237.01	254.60	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	(71)
Water heating gains (Table 5)	94.99	93.08	89.11	83.71	80.21	75.28	71.09	76.46	78.37	83.95	90.26	93.08	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	491.28	487.69	470.16	442.96	415.25	390.19	375.35	382.40	397.88	425.27	455.78	478.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	13.66	x	19.64	x 0.9 x	0.50	x	0.90	=	83.66	(76)

Solar gains in watts ∑(74)m...(82)m

83.66	163.67	269.54	393.10	481.76	493.17	469.52	403.31	313.48	194.20	104.32	68.80	(83)

Total gains - internal and solar (73)m + (83)m

574.95	651.36	739.69	836.06	897.01	883.36	844.87	785.71	711.36	619.47	560.10	547.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.92	0.85	0.70	0.51	0.37	0.25	0.18	0.20	0.34	0.59	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.87	20.94	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.96	20.85	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.44	20.44	20.45	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.45	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.83	0.68	0.49	0.34	0.23	0.16	0.18	0.31	0.56	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.28	20.37	20.43	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.41	20.26	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.50	20.59	20.65	20.67	20.67	20.68	20.68	20.68	20.67	20.67	20.62	20.49	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.50	20.59	20.65	20.67	20.67	20.68	20.68	20.68	20.67	20.67	20.62	20.49	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.83	0.69	0.50	0.35	0.24	0.17	0.19	0.32	0.57	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	524.25	541.37	506.73	416.55	316.29	209.31	140.40	146.64	228.58	354.11	459.44	507.74	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	592.70	571.44	512.83	416.91	316.30	209.31	140.40	146.64	228.58	355.03	481.20	585.14	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	50.93	20.21	4.54	0.26	0.01	0.00	0.00	0.00	0.00	0.69	15.66	57.58	

∑(98)1...5, 10...12 = 149.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.41 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		1.00 (303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	149.88	(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	157.38 (307a)

Water heating

Annual water heating requirement	1681.31	(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1765.38 (310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	19.23 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	94.86	(330a)
Total electricity for the above, kWh/year		94.86 (331)
Electricity for lighting (Appendix L)		280.97 (332)

Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2298.58	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	157.38	x	4.24	x 0.01 =	6.67	(340a)
Water heating from boilers	1765.38	x	4.24	x 0.01 =	74.85	(342a)
Pumps and fans	94.86	x	13.19	x 0.01 =	12.51	(349)
Electricity for lighting	280.97	x	13.19	x 0.01 =	37.06	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		251.10	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.98	(357)
SAP value	86.28	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1974.08	x	0.216	=	426.40	(367)
Electrical energy for community heat distribution	19.23	x	0.519	=	9.98	(372)
Total CO2 associated with community systems					436.38	(373)
Total CO2 associated with space and water heating					436.38	(376)
Pumps and fans	94.86	x	0.519	=	49.23	(378)
Electricity for lighting	280.97	x	0.519	=	145.82	(379)
Total CO_2, kg/year				(376)..(382) =	631.43	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.15	(384)
EI value					92.11	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1974.08	x	1.22	=	2408.38	(367)
Electrical energy for community heat distribution	19.23	x	3.07	=	59.03	(372)
Total primary energy associated with community systems					2467.41	(373)
Total primary energy associated with space and water heating					2467.41	(376)
Pumps and fans	94.86	x	3.07	=	291.20	(378)
Electricity for lighting	280.97	x	3.07	=	862.58	(379)
Primary energy kWh/year					3621.20	(383)
Dwelling primary energy rate kWh/m2/year					58.22	(384)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	No 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		62.20	(1a) x	2.50	(2a) =	155.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	62.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	155.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.66	x	1.24	=	16.88			(27)
External wall			13.84	x	0.15	=	2.08			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			27.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.96 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.13 (36)
Total fabric heat loss	(33) + (36) =	23.08 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	13.50	13.34	13.17	12.35	12.19	11.37	11.37	11.21	11.70	12.19	12.52	12.84	(38)
Heat transfer coefficient, W/K (37)m + (38)m	36.58	36.42	36.25	35.44	35.27	34.45	34.45	34.29	34.78	35.27	35.60	35.93	

Average = ∑(39)1...12/12 = 35.39 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.59	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	

Average = ∑(40)1...12/12 = 0.57 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.04 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.72 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	91.00	87.69	84.38	81.07	77.76	74.45	74.45	77.76	81.07	84.38	87.69	91.00	

∑(44)1...12 = 992.68 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	134.94	118.02	121.79	106.18	101.88	87.92	81.47	93.48	94.60	110.25	120.34	130.69	

∑(45)1...12 = 1301.57 (45)

Distribution loss 0.15 x (45)m	20.24	17.70	18.27	15.93	15.28	13.19	12.22	14.02	14.19	16.54	18.05	19.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)
Primary circuit loss for each month from Table 3	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	

∑(64)1...12 = 1681.31 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.67	62.55	66.30	60.27	59.68	54.20	52.89	56.89	56.42	62.46	64.98	69.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.77	35.33	28.73	21.75	16.26	13.73	14.83	19.28	25.88	32.86	38.35	40.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.36	269.12	262.16	247.33	228.61	211.02	199.27	196.50	203.47	218.30	237.01	254.60	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	(71)
Water heating gains (Table 5)	94.99	93.08	89.11	83.71	80.21	75.28	71.09	76.46	78.37	83.95	90.26	93.08	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	491.28	487.69	470.16	442.96	415.25	390.19	375.35	382.40	397.88	425.27	455.78	478.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	13.66	x	19.64	x 0.9 x	0.50	x	0.90	=	83.66	(76)

Solar gains in watts ∑(74)m...(82)m

83.66	163.67	269.54	393.10	481.76	493.17	469.52	403.31	313.48	194.20	104.32	68.80	(83)

Total gains - internal and solar (73)m + (83)m

574.95	651.36	739.69	836.06	897.01	883.36	844.87	785.71	711.36	619.47	560.10	547.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.92	0.85	0.70	0.51	0.37	0.25	0.18	0.20	0.34	0.59	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.87	20.94	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.96	20.85	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.44	20.44	20.45	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.45	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.83	0.68	0.49	0.34	0.23	0.16	0.18	0.31	0.56	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.28	20.37	20.43	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.41	20.26	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.50	20.59	20.65	20.67	20.67	20.68	20.68	20.68	20.67	20.67	20.62	20.49	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.50	20.59	20.65	20.67	20.67	20.68	20.68	20.68	20.67	20.67	20.62	20.49	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.83	0.69	0.50	0.35	0.24	0.17	0.19	0.32	0.57	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	524.25	541.37	506.73	416.55	316.29	209.31	140.40	146.64	228.58	354.11	459.44	507.74	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	592.70	571.44	512.83	416.91	316.30	209.31	140.40	146.64	228.58	355.03	481.20	585.14	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	50.93	20.21	4.54	0.26	0.01	0.00	0.00	0.00	0.00	0.69	15.66	57.58	

∑(98)1...5, 10...12 = 149.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.41 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		0.80 (303a)
Fraction of community heat from CHP		0.20 (303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20 (304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	149.88		(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	31.48 (307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	125.90 (307b)

Water heating

Annual water heating requirement	1681.31		(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	353.08 (310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) =	1412.30 (310b)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	19.23 (313)

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Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	94.86		(330a)
Total electricity for the above, kWh/year		94.86	(331)
Electricity for lighting (Appendix L)		280.97	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2298.58	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	31.48	x	2.97	x 0.01 =	0.93	(340a)
Space heating from boilers	125.90	x	4.24	x 0.01 =	5.34	(340b)
Water heating from CHP	353.08	x	2.97	x 0.01 =	10.49	(342a)
Water heating from boilers	1412.30	x	4.24	x 0.01 =	59.88	(342b)
Pumps and fans	94.86	x	13.19	x 0.01 =	12.51	(349)
Electricity for lighting	280.97	x	13.19	x 0.01 =	37.06	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		246.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.54	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	58.2403	x	0.2160	=	12.5799	(363)
less credit emissions for electricity		-19.3101	x	0.5190	=	-10.0219	(364)
Water heated by CHP		653.3101	x	0.2160	=	141.1150	(365)
less credit emissions for electricity		-216.6108	x	0.5190	=	-112.4210	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1579.27	x	0.216	=	341.12	(368)
Electrical energy for community heat distribution		19.23	x	0.519	=	9.98	(372)
Total CO2 associated with community systems						382.35	(373)
Total CO2 associated with space and water heating						382.35	(376)
Pumps and fans		94.86	x	0.519	=	49.23	(378)
Electricity for lighting		280.97	x	0.519	=	145.82	(379)
Total CO_2, kg/year					(376)..(382) =	577.41	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.28	(384)
EI value						92.78	
EI rating (section 14)						93	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	58.24	x	1.22	=	71.05	(363)
less credit energy for electricity		-19.31	x	3.07	=	-59.28	(364)
Water heated by CHP		653.31	x	1.22	=	797.04	(365)
less credit energy for electricity		-216.61	x	3.07	=	-665.00	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1579.27	x	1.22	=	1926.70	(368)
Electrical energy for community heat distribution		19.23	x	3.07	=	59.03	(372)
Total primary energy associated with community systems						2129.55	(373)
Total primary energy associated with space and water heating						2129.55	(376)
Pumps and fans		94.86	x	3.07	=	291.20	(378)
Electricity for lighting		280.97	x	3.07	=	862.58	(379)
Primary energy kWh/year						3283.33	(383)
Dwelling primary energy rate kWh/m2/year						52.79	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	No 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		62.20	(1a) x	2.50	(2a) =	155.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	62.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	155.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.66	x	1.24	=	16.88			(27)
External wall			13.84	x	0.15	=	2.08			(29a)
Party wall			55.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			27.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	18.96 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		4.13 (36)
Total fabric heat loss	(33) + (36) =	23.08 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	13.50	13.34	13.17	12.35	12.19	11.37	11.37	11.21	11.70	12.19	12.52	12.84	(38)
Heat transfer coefficient, W/K (37)m + (38)m	36.58	36.42	36.25	35.44	35.27	34.45	34.45	34.29	34.78	35.27	35.60	35.93	

Average = ∑(39)1...12/12 = 35.39 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.59	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	

Average = ∑(40)1...12/12 = 0.57 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.04 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.72 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	91.00	87.69	84.38	81.07	77.76	74.45	74.45	77.76	81.07	84.38	87.69	91.00	

∑(44)1...12 = 992.68 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	134.94	118.02	121.79	106.18	101.88	87.92	81.47	93.48	94.60	110.25	120.34	130.69	

∑(45)1...12 = 1301.57 (45)

Distribution loss 0.15 x (45)m	20.24	17.70	18.27	15.93	15.28	13.19	12.22	14.02	14.19	16.54	18.05	19.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)
Primary circuit loss for each month from Table 3	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

167.20	147.15	154.04	137.39	134.13	119.13	113.72	125.74	125.81	142.50	151.56	162.94	

∑(64)1...12 = 1681.31 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.67	62.55	66.30	60.27	59.68	54.20	52.89	56.89	56.42	62.46	64.98	69.26	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	122.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.77	35.33	28.73	21.75	16.26	13.73	14.83	19.28	25.88	32.86	38.35	40.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.36	269.12	262.16	247.33	228.61	211.02	199.27	196.50	203.47	218.30	237.01	254.60	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	49.30	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	-81.72	(71)
Water heating gains (Table 5)	94.99	93.08	89.11	83.71	80.21	75.28	71.09	76.46	78.37	83.95	90.26	93.08	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	491.28	487.69	470.16	442.96	415.25	390.19	375.35	382.40	397.88	425.27	455.78	478.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	13.66	x	19.64	x 0.9 x	0.50	x	0.90	=	83.66	(76)

Solar gains in watts ∑(74)m...(82)m

83.66	163.67	269.54	393.10	481.76	493.17	469.52	403.31	313.48	194.20	104.32	68.80	(83)

Total gains - internal and solar (73)m + (83)m

574.95	651.36	739.69	836.06	897.01	883.36	844.87	785.71	711.36	619.47	560.10	547.54	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.92	0.85	0.70	0.51	0.37	0.25	0.18	0.20	0.34	0.59	0.84	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.87	20.94	20.99	21.00	21.00	21.00	21.00	21.00	21.00	21.00	20.96	20.85	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.44	20.44	20.45	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.45	20.45	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.83	0.68	0.49	0.34	0.23	0.16	0.18	0.31	0.56	0.81	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

20.28	20.37	20.43	20.46	20.46	20.47	20.47	20.47	20.47	20.46	20.41	20.26	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.50	20.59	20.65	20.67	20.67	20.68	20.68	20.68	20.67	20.67	20.62	20.49	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.50	20.59	20.65	20.67	20.67	20.68	20.68	20.68	20.67	20.67	20.62	20.49	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.91	0.83	0.69	0.50	0.35	0.24	0.17	0.19	0.32	0.57	0.82	0.93	(94)
Useful gains, ηmGm, W (94)m x (84)m	524.25	541.37	506.73	416.55	316.29	209.31	140.40	146.64	228.58	354.11	459.44	507.74	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	592.70	571.44	512.83	416.91	316.30	209.31	140.40	146.64	228.58	355.03	481.20	585.14	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	50.93	20.21	4.54	0.26	0.01	0.00	0.00	0.00	0.00	0.69	15.66	57.58	

∑(98)1...5, 10...12 = 149.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 2.41 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00 (301)
Fraction of space heat from community system	1 - (301) =	1.00 (302)
Fraction of community heat from boilers		0.80 (303a)
Fraction of community heat from CHP		0.20 (303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20 (304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80 (304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00 (305)
Factor for charging method (Table 4c(3)) for community water heating		1.00 (305a)
Distribution loss factor (Table 12c) for community heating system		1.05 (306)

Space heating

Annual space heating requirement	149.88		(98)
Space heat from CHP		(98) x (304a) x (305) x (306) =	31.48 (307a)
Space heat from boilers		(98) x (304b) x (305) x (306) =	125.90 (307b)

Water heating

Annual water heating requirement	1681.31		(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) =	353.08 (310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) =	1412.30 (310b)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	19.23 (313)

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Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	94.86		(330a)
Total electricity for the above, kWh/year		94.86	(331)
Electricity for lighting (Appendix L)		280.97	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2065.40	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	31.48	x	2.97	x 0.01 =	0.93	(340a)
Space heating from boilers	125.90	x	4.24	x 0.01 =	5.34	(340b)
Water heating from CHP	353.08	x	2.97	x 0.01 =	10.49	(342a)
Water heating from boilers	1412.30	x	4.24	x 0.01 =	59.88	(342b)
Pumps and fans	94.86	x	13.19	x 0.01 =	12.51	(349)
Electricity for lighting	280.97	x	13.19	x 0.01 =	37.06	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		246.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.54	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	58.2403	x	0.2160	=	12.5799	(363)
less credit emissions for electricity		-19.3101	x	0.5190	=	-10.0219	(364)
Water heated by CHP		653.3101	x	0.2160	=	141.1150	(365)
less credit emissions for electricity		-216.6108	x	0.5190	=	-112.4210	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1579.27	x	0.216	=	341.12	(368)
Electrical energy for community heat distribution		19.23	x	0.519	=	9.98	(372)
Total CO2 associated with community systems						382.35	(373)
Total CO2 associated with space and water heating						382.35	(376)
Pumps and fans		94.86	x	0.519	=	49.23	(378)
Electricity for lighting		280.97	x	0.519	=	145.82	(379)
Energy saving/generation technologies							
pv savings		-233.18	x	0.519	=	-121.02	(380)

Total CO_2, kg/year	(376)..(382) =	456.39	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	7.34	(384)
EI value		94.30	
EI rating (section 14)		94	(385)
EI band		A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	58.24	x	1.22	=	71.05	(363)
less credit energy for electricity		-19.31	x	3.07	=	-59.28	(364)
Water heated by CHP		653.31	x	1.22	=	797.04	(365)
less credit energy for electricity		-216.61	x	3.07	=	-665.00	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1579.27	x	1.22	=	1926.70	(368)
Electrical energy for community heat distribution		19.23	x	3.07	=	59.03	(372)
Total primary energy associated with community systems						2129.55	(373)
Total primary energy associated with space and water heating						2129.55	(376)
Pumps and fans		94.86	x	3.07	=	291.20	(378)
Electricity for lighting		280.97	x	3.07	=	862.58	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2567.48	(383)
Dwelling primary energy rate kWh/m2/year						41.28	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Of 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
Exposed floor			60.80	x	0.19	=	11.49			(28b
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			103.30							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.07 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.50 (36)
Total fabric heat loss	(33) + (36) =	47.56 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.76	60.60	60.44	59.64	59.48	58.68	58.68	58.52	59.00	59.48	59.80	60.12	

Average = ∑(39)1...12/12 = 59.60 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	0.99	0.98	0.98	0.97	0.97	0.96	0.97	0.98	0.98	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.80 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	

∑(44)1...12 = 981.59 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	

∑(45)1...12 = 1287.01 (45)

Distribution loss 0.15 x (45)m

20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.97	0.94	0.84	0.67	0.48	0.35	0.39	0.63	0.89	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.24	20.38	20.60	20.84	20.96	21.00	21.00	21.00	20.98	20.81	20.49	20.21	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.08	20.09	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.10	20.09	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.93	0.81	0.61	0.41	0.28	0.31	0.56	0.85	0.96	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.10	19.29	19.60	19.93	20.07	20.11	20.11	20.11	20.09	19.90	19.46	19.06	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.54	19.71	19.98	20.28	20.41	20.45	20.45	20.45	20.44	20.25	19.86	19.51	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.54	19.71	19.98	20.28	20.41	20.45	20.45	20.45	20.44	20.25	19.86	19.51	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.92	0.81	0.63	0.44	0.30	0.34	0.58	0.86	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	533.39	577.49	610.55	599.65	501.43	341.69	225.98	236.97	365.84	482.82	503.98	512.84	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	925.84	897.50	814.95	678.56	518.24	343.32	226.13	237.28	373.77	573.99	762.91	920.22	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	291.98	215.05	152.07	56.82	12.50	0.00	0.00	0.00	0.00	67.83	186.43	303.09	

∑(98)1...5, 10...12 = 1285.77 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.15 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1285.77		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1350.06	(307a)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1750.10	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	31.00	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	92.72	(330a)

Total electricity for the above, kWh/year		92.72	(331)
Electricity for lighting (Appendix L)		275.46	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3468.34	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1350.06	x	4.24	x 0.01 =	57.24	(340a)
Water heating from boilers	1750.10	x	4.24	x 0.01 =	74.20	(342a)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	300.01	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.39	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3182.91	x	0.216	=	687.51	(367)
Electrical energy for community heat distribution		31.00	x	0.519	=	16.09	(372)
Total CO2 associated with community systems						703.60	(373)
Total CO2 associated with space and water heating						703.60	(376)
Pumps and fans		92.72	x	0.519	=	48.12	(378)
Electricity for lighting		275.46	x	0.519	=	142.96	(379)
Total CO_2, kg/year					(376)..(382) =	894.69	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	14.72	(384)
EI value						88.67	
EI rating (section 14)						89	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3182.91	x	1.22	=	3883.15	(367)
Electrical energy for community heat distribution		31.00	x	3.07	=	95.17	(372)
Total primary energy associated with community systems						3978.33	(373)
Total primary energy associated with space and water heating						3978.33	(376)
Pumps and fans		92.72	x	3.07	=	284.65	(378)
Electricity for lighting		275.46	x	3.07	=	845.67	(379)
Primary energy kWh/year						5108.65	(383)

Dwelling primary energy rate kWh/m2/year	84.02	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Of 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
Exposed floor			60.80	x	0.19	=	11.49			(28b
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			103.30							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.07 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.50 (36)
Total fabric heat loss	(33) + (36) =	47.56 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.76	60.60	60.44	59.64	59.48	58.68	58.68	58.52	59.00	59.48	59.80	60.12	

Average = ∑(39)1...12/12 = 59.60 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	0.99	0.98	0.98	0.97	0.97	0.96	0.97	0.98	0.98	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.80 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	

∑(44)1...12 = 981.59 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	

∑(45)1...12 = 1287.01 (45)

Distribution loss 0.15 x (45)m

20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.97	0.94	0.84	0.67	0.48	0.35	0.39	0.63	0.89	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.24	20.38	20.60	20.84	20.96	21.00	21.00	21.00	20.98	20.81	20.49	20.21

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.08	20.09	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.10	20.09

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.93	0.81	0.61	0.41	0.28	0.31	0.56	0.85	0.96	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.10	19.29	19.60	19.93	20.07	20.11	20.11	20.11	20.09	19.90	19.46	19.06

(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.54	19.71	19.98	20.28	20.41	20.45	20.45	20.45	20.44	20.25	19.86	19.51

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.54	19.71	19.98	20.28	20.41	20.45	20.45	20.45	20.44	20.25	19.86	19.51

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.92	0.81	0.63	0.44	0.30	0.34	0.58	0.86	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	533.39	577.49	610.55	599.65	501.43	341.69	225.98	236.97	365.84	482.82	503.98	512.84	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	925.84	897.50	814.95	678.56	518.24	343.32	226.13	237.28	373.77	573.99	762.91	920.22	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	291.98	215.05	152.07	56.82	12.50	0.00	0.00	0.00	0.00	67.83	186.43	303.09	

∑(98)1...5, 10...12 = 1285.77 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.15 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1285.77		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	270.01	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1080.05	(307b)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	350.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1400.08	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	31.00	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	92.72		(330a)
Total electricity for the above, kWh/year		92.72	(331)
Electricity for lighting (Appendix L)		275.46	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3468.34	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	270.01	x	2.97	x 0.01 =	8.02	(340a)
Space heating from boilers	1080.05	x	4.24	x 0.01 =	45.79	(340b)
Water heating from CHP	350.02	x	2.97	x 0.01 =	10.40	(342a)
Water heating from boilers	1400.08	x	4.24	x 0.01 =	59.36	(342b)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		292.14	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.16	(357)
SAP value	83.82	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	499.6134	x	0.2160	=	107.9165	(363)
less credit emissions for electricity		-165.6513	x	0.5190	=	-85.9730	(364)
Water heated by CHP		647.6555	x	0.2160	=	139.8936	(365)
less credit emissions for electricity		-214.7360	x	0.5190	=	-111.4480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2546.33	x	0.216	=	550.01	(368)
Electrical energy for community heat distribution		31.00	x	0.519	=	16.09	(372)
Total CO2 associated with community systems						616.49	(373)
Total CO2 associated with space and water heating						616.49	(376)
Pumps and fans		92.72	x	0.519	=	48.12	(378)
Electricity for lighting		275.46	x	0.519	=	142.96	(379)
Total CO_2, kg/year					(376)..(382) =	807.57	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	13.28	(384)
EI value						89.77	
EI rating (section 14)						90	(385)

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EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	499.61	x	1.22	=	609.53	(363)
less credit energy for electricity		-165.65	x	3.07	=	-508.55	(364)
Water heated by CHP		647.66	x	1.22	=	790.14	(365)
less credit energy for electricity		-214.74	x	3.07	=	-659.24	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2546.33	x	1.22	=	3106.52	(368)
Electrical energy for community heat distribution		31.00	x	3.07	=	95.17	(372)
Total primary energy associated with community systems						3433.58	(373)
Total primary energy associated with space and water heating						3433.58	(376)
Pumps and fans		92.72	x	3.07	=	284.65	(378)
Electricity for lighting		275.46	x	3.07	=	845.67	(379)
Primary energy kWh/year						4563.89	(383)
Dwelling primary energy rate kWh/m2/year						75.06	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Of 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
Exposed floor			60.80	x	0.19	=	11.49			(28b
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			103.30							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.07 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.50 (36)
Total fabric heat loss	(33) + (36) =	47.56 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)

Heat transfer coefficient, W/K (37)m + (38)m

60.76	60.60	60.44	59.64	59.48	58.68	58.68	58.52	59.00	59.48	59.80	60.12	

Average = ∑(39)1...12/12 = 59.60 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	0.99	0.98	0.98	0.97	0.97	0.96	0.97	0.98	0.98	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.80 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	

∑(44)1...12 = 981.59 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	

∑(45)1...12 = 1287.01 (45)

Distribution loss 0.15 x (45)m

20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.97	0.94	0.84	0.67	0.48	0.35	0.39	0.63	0.89	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.24	20.38	20.60	20.84	20.96	21.00	21.00	21.00	20.98	20.81	20.49	20.21

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.08	20.09	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.10	20.09

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.93	0.81	0.61	0.41	0.28	0.31	0.56	0.85	0.96	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.10	19.29	19.60	19.93	20.07	20.11	20.11	20.11	20.09	19.90	19.46	19.06

(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.54	19.71	19.98	20.28	20.41	20.45	20.45	20.45	20.44	20.25	19.86	19.51

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.54	19.71	19.98	20.28	20.41	20.45	20.45	20.45	20.44	20.25	19.86	19.51

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.92	0.81	0.63	0.44	0.30	0.34	0.58	0.86	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	533.39	577.49	610.55	599.65	501.43	341.69	225.98	236.97	365.84	482.82	503.98	512.84	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	925.84	897.50	814.95	678.56	518.24	343.32	226.13	237.28	373.77	573.99	762.91	920.22	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	291.98	215.05	152.07	56.82	12.50	0.00	0.00	0.00	0.00	67.83	186.43	303.09	

∑(98)1...5, 10...12 = 1285.77 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.15 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1285.77		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	270.01	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1080.05	(307b)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	350.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1400.08	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	31.00	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	92.72		(330a)
Total electricity for the above, kWh/year		92.72	(331)
Electricity for lighting (Appendix L)		275.46	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3235.16	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	270.01	x	2.97	x 0.01 =	8.02	(340a)
Space heating from boilers	1080.05	x	4.24	x 0.01 =	45.79	(340b)
Water heating from CHP	350.02	x	2.97	x 0.01 =	10.40	(342a)
Water heating from boilers	1400.08	x	4.24	x 0.01 =	59.36	(342b)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		292.14	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.16	(357)
SAP value	83.82	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	499.6134	x	0.2160	=	107.9165	(363)
less credit emissions for electricity		-165.6513	x	0.5190	=	-85.9730	(364)
Water heated by CHP		647.6555	x	0.2160	=	139.8936	(365)
less credit emissions for electricity		-214.7360	x	0.5190	=	-111.4480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2546.33	x	0.216	=	550.01	(368)
Electrical energy for community heat distribution		31.00	x	0.519	=	16.09	(372)
Total CO2 associated with community systems						616.49	(373)
Total CO2 associated with space and water heating						616.49	(376)
Pumps and fans		92.72	x	0.519	=	48.12	(378)
Electricity for lighting		275.46	x	0.519	=	142.96	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	686.55	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.29	(384)
EI value					91.30	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	499.61	x	1.22	=	609.53	(363)
less credit energy for electricity		-165.65	x	3.07	=	-508.55	(364)
Water heated by CHP		647.66	x	1.22	=	790.14	(365)
less credit energy for electricity		-214.74	x	3.07	=	-659.24	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2546.33	x	1.22	=	3106.52	(368)
Electrical energy for community heat distribution		31.00	x	3.07	=	95.17	(372)
Total primary energy associated with community systems						3433.58	(373)
Total primary energy associated with space and water heating						3433.58	(376)
Pumps and fans		92.72	x	3.07	=	284.65	(378)
Electricity for lighting		275.46	x	3.07	=	845.67	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3848.04	(383)
Dwelling primary energy rate kWh/m2/year						63.29	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Oo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			42.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.58 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.38 (36)
Total fabric heat loss	(33) + (36) =	26.95 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)

Heat transfer coefficient, W/K (37)m + (38)m

40.15	39.99	39.83	39.03	38.87	38.07	38.07	37.91	38.39	38.87	39.19	39.51	

Average = ∑(39)1...12/12 = 38.99 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.66	0.66	0.66	0.64	0.64	0.63	0.63	0.62	0.63	0.64	0.64	0.65	

Average = ∑(40)1...12/12 = 0.64 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		81.80 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	

∑(44)1...12 = 981.59 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	

∑(45)1...12 = 1287.01 (45)

Distribution loss 0.15 x (45)m

20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.92	0.82	0.64	0.46	0.31	0.22	0.25	0.42	0.71	0.91	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.75	20.84	20.94	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.73	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.38	20.38	20.38	20.39	20.39	20.41	20.41	20.41	20.40	20.39	20.39	20.39	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.95	0.90	0.80	0.60	0.43	0.28	0.19	0.22	0.39	0.67	0.89	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.06	20.19	20.31	20.38	20.39	20.41	20.41	20.41	20.40	20.38	20.25	20.04	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.32	20.44	20.56	20.62	20.63	20.63	20.63	20.64	20.63	20.61	20.50	20.30	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.32	20.44	20.56	20.62	20.63	20.63	20.63	20.64	20.63	20.61	20.50	20.30	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.80	0.62	0.44	0.29	0.21	0.23	0.40	0.68	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	516.60	542.23	531.11	453.84	346.76	229.73	153.60	160.59	250.67	383.14	467.86	499.59	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	643.28	621.31	559.80	457.35	346.98	229.74	153.60	160.59	250.75	389.24	524.95	636.24	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	94.25	53.14	21.35	2.53	0.16	0.00	0.00	0.00	0.00	4.54	41.10	101.67	

∑(98)1...5, 10...12 = 318.73 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.24 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	318.73		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	334.67	(307a)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1750.10	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.85	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	92.72		(330a)
Total electricity for the above, kWh/year		92.72	(331)

Electricity for lighting (Appendix L)		275.46	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2452.95	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	334.67	x	4.24	x 0.01 =	14.19	(340a)
Water heating from boilers	1750.10	x	4.24	x 0.01 =	74.20	(342a)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		256.96	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.02	(357)
SAP value	85.77	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2140.42	x	0.216	=	462.33	(367)
Electrical energy for community heat distribution	20.85	x	0.519	=	10.82	(372)
Total CO2 associated with community systems					473.15	(373)
Total CO2 associated with space and water heating					473.15	(376)
Pumps and fans	92.72	x	0.519	=	48.12	(378)
Electricity for lighting	275.46	x	0.519	=	142.96	(379)
Total CO_2, kg/year				(376)..(382) =	664.24	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.92	(384)
EI value					91.59	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2140.42	x	1.22	=	2611.31	(367)
Electrical energy for community heat distribution	20.85	x	3.07	=	64.00	(372)
Total primary energy associated with community systems					2675.32	(373)
Total primary energy associated with space and water heating					2675.32	(376)
Pumps and fans	92.72	x	3.07	=	284.65	(378)
Electricity for lighting	275.46	x	3.07	=	845.67	(379)
Primary energy kWh/year					3805.63	(383)
Dwelling primary energy rate kWh/m2/year					62.59	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Oo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			42.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.58 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.38 (36)
Total fabric heat loss	(33) + (36) =	26.95 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)

Heat transfer coefficient, W/K (37)m + (38)m

40.15	39.99	39.83	39.03	38.87	38.07	38.07	37.91	38.39	38.87	39.19	39.51	

Average = ∑(39)1...12/12 = 38.99 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.66	0.66	0.66	0.64	0.64	0.63	0.63	0.62	0.63	0.64	0.64	0.65	

Average = ∑(40)1...12/12 = 0.64 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.80 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	

∑(44)1...12 = 981.59 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	

∑(45)1...12 = 1287.01 (45)

Distribution loss 0.15 x (45)m

20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.92	0.82	0.64	0.46	0.31	0.22	0.25	0.42	0.71	0.91	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.75	20.84	20.94	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.73	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.38	20.38	20.38	20.39	20.39	20.41	20.41	20.41	20.40	20.39	20.39	20.39	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.95	0.90	0.80	0.60	0.43	0.28	0.19	0.22	0.39	0.67	0.89	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.06	20.19	20.31	20.38	20.39	20.41	20.41	20.41	20.40	20.38	20.25	20.04	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.32	20.44	20.56	20.62	20.63	20.63	20.63	20.64	20.63	20.61	20.50	20.30	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.32	20.44	20.56	20.62	20.63	20.63	20.63	20.64	20.63	20.61	20.50	20.30	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.80	0.62	0.44	0.29	0.21	0.23	0.40	0.68	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	516.60	542.23	531.11	453.84	346.76	229.73	153.60	160.59	250.67	383.14	467.86	499.59	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	643.28	621.31	559.80	457.35	346.98	229.74	153.60	160.59	250.75	389.24	524.95	636.24	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	94.25	53.14	21.35	2.53	0.16	0.00	0.00	0.00	0.00	4.54	41.10	101.67	

∑(98)1...5, 10...12 = 318.73 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.24 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	318.73		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	66.93	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	267.74	(307b)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	350.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1400.08	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.85	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	92.72		(330a)
Total electricity for the above, kWh/year		92.72	(331)
Electricity for lighting (Appendix L)		275.46	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2452.95	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	66.93	x	2.97	x 0.01 =	1.99	(340a)
Space heating from boilers	267.74	x	4.24	x 0.01 =	11.35	(340b)
Water heating from CHP	350.02	x	2.97	x 0.01 =	10.40	(342a)
Water heating from boilers	1400.08	x	4.24	x 0.01 =	59.36	(342b)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		251.66	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	86.06	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	123.8512	x	0.2160	=	26.7519	(363)
less credit emissions for electricity		-41.0640	x	0.5190	=	-21.3122	(364)
Water heated by CHP		647.6555	x	0.2160	=	139.8936	(365)
less credit emissions for electricity		-214.7360	x	0.5190	=	-111.4480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1712.34	x	0.216	=	369.86	(368)
Electrical energy for community heat distribution		20.85	x	0.519	=	10.82	(372)
Total CO2 associated with community systems						414.57	(373)
Total CO2 associated with space and water heating						414.57	(376)
Pumps and fans		92.72	x	0.519	=	48.12	(378)
Electricity for lighting		275.46	x	0.519	=	142.96	(379)
Total CO_2, kg/year					(376)..(382) =	605.66	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.96	(384)
EI value						92.33	
EI rating (section 14)						92	(385)
EI band						A	

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13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	123.85	x	1.22	=	151.10	(363)
less credit energy for electricity		-41.06	x	3.07	=	-126.07	(364)
Water heated by CHP		647.66	x	1.22	=	790.14	(365)
less credit energy for electricity		-214.74	x	3.07	=	-659.24	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1712.34	x	1.22	=	2089.05	(368)
Electrical energy for community heat distribution		20.85	x	3.07	=	64.00	(372)
Total primary energy associated with community systems						2308.99	(373)
Total primary energy associated with space and water heating						2308.99	(376)
Pumps and fans		92.72	x	3.07	=	284.65	(378)
Electricity for lighting		275.46	x	3.07	=	845.67	(379)
Primary energy kWh/year						3439.30	(383)
Dwelling primary energy rate kWh/m2/year						56.57	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Oo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			42.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.58 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		6.38 (36)
Total fabric heat loss	(33) + (36) =	26.95 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)

Heat transfer coefficient, W/K (37)m + (38)m

40.15	39.99	39.83	39.03	38.87	38.07	38.07	37.91	38.39	38.87	39.19	39.51	

Average = ∑(39)1...12/12 = 38.99 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.66	0.66	0.66	0.64	0.64	0.63	0.63	0.62	0.63	0.64	0.64	0.65	

Average = ∑(40)1...12/12 = 0.64 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		81.80 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	

∑(44)1...12 = 981.59 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	

∑(45)1...12 = 1287.01 (45)

Distribution loss 0.15 x (45)m

20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.92	0.82	0.64	0.46	0.31	0.22	0.25	0.42	0.71	0.91	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.75	20.84	20.94	20.99	21.00	21.00	21.00	21.00	21.00	20.99	20.88	20.73	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.38	20.38	20.38	20.39	20.39	20.41	20.41	20.41	20.40	20.39	20.39	20.39	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.95	0.90	0.80	0.60	0.43	0.28	0.19	0.22	0.39	0.67	0.89	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	20.06	20.19	20.31	20.38	20.39	20.41	20.41	20.41	20.40	20.38	20.25	20.04	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.32	20.44	20.56	20.62	20.63	20.63	20.63	20.64	20.63	20.61	20.50	20.30	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.32	20.44	20.56	20.62	20.63	20.63	20.63	20.64	20.63	20.61	20.50	20.30	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.90	0.80	0.62	0.44	0.29	0.21	0.23	0.40	0.68	0.89	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	516.60	542.23	531.11	453.84	346.76	229.73	153.60	160.59	250.67	383.14	467.86	499.59	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	643.28	621.31	559.80	457.35	346.98	229.74	153.60	160.59	250.75	389.24	524.95	636.24	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	94.25	53.14	21.35	2.53	0.16	0.00	0.00	0.00	0.00	4.54	41.10	101.67	

∑(98)1...5, 10...12 = 318.73 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 5.24 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	318.73		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	66.93	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	267.74	(307b)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	350.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1400.08	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	20.85	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	92.72		(330a)
Total electricity for the above, kWh/year		92.72	(331)
Electricity for lighting (Appendix L)		275.46	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2219.77	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	66.93	x	2.97	x 0.01 =	1.99	(340a)
Space heating from boilers	267.74	x	4.24	x 0.01 =	11.35	(340b)
Water heating from CHP	350.02	x	2.97	x 0.01 =	10.40	(342a)
Water heating from boilers	1400.08	x	4.24	x 0.01 =	59.36	(342b)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		251.66	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	86.06	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	123.8512	x	0.2160	=	26.7519	(363)
less credit emissions for electricity		-41.0640	x	0.5190	=	-21.3122	(364)
Water heated by CHP		647.6555	x	0.2160	=	139.8936	(365)
less credit emissions for electricity		-214.7360	x	0.5190	=	-111.4480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1712.34	x	0.216	=	369.86	(368)
Electrical energy for community heat distribution		20.85	x	0.519	=	10.82	(372)
Total CO2 associated with community systems						414.57	(373)
Total CO2 associated with space and water heating						414.57	(376)
Pumps and fans		92.72	x	0.519	=	48.12	(378)
Electricity for lighting		275.46	x	0.519	=	142.96	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	484.64	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.97	(384)
EI value					93.86	
EI rating (section 14)					94	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	123.85	x	1.22	=	151.10	(363)
less credit energy for electricity		-41.06	x	3.07	=	-126.07	(364)
Water heated by CHP		647.66	x	1.22	=	790.14	(365)
less credit energy for electricity		-214.74	x	3.07	=	-659.24	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1712.34	x	1.22	=	2089.05	(368)
Electrical energy for community heat distribution		20.85	x	3.07	=	64.00	(372)
Total primary energy associated with community systems						2308.99	(373)
Total primary energy associated with space and water heating						2308.99	(376)
Pumps and fans		92.72	x	3.07	=	284.65	(378)
Electricity for lighting		275.46	x	3.07	=	845.67	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2723.45	(383)
Dwelling primary energy rate kWh/m2/year						44.79	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Or 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Roof			30.16	x	0.12	=	3.62			(30)
Total area of external elements ∑A, m²			72.66							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.20 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		10.90 (36)
Total fabric heat loss	(33) + (36) =	35.09 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)

Heat transfer coefficient, W/K (37)m + (38)m

48.29	48.13	47.97	47.17	47.01	46.21	46.21	46.05	46.53	47.01	47.33	47.65	

Average = ∑(39)1...12/12 = 47.13 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.79	0.79	0.79	0.78	0.77	0.76	0.76	0.76	0.77	0.77	0.78	0.78	

Average = ∑(40)1...12/12 = 0.78 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.80 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	

∑(44)1...12 = 981.59 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	

∑(45)1...12 = 1287.01 (45)

Distribution loss 0.15 x (45)m

20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.89	0.74	0.55	0.38	0.27	0.31	0.51	0.81	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.55	20.67	20.83	20.96	20.99	21.00	21.00	21.00	21.00	20.94	20.74	20.52

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.26	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.28	20.28	20.27	20.27

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.94	0.87	0.70	0.51	0.34	0.23	0.26	0.46	0.77	0.94	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.67	19.84	20.06	20.23	20.27	20.29	20.29	20.29	20.28	20.22	19.95	19.65

(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.01	20.16	20.36	20.51	20.55	20.56	20.56	20.56	20.56	20.50	20.25	19.98

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.01	20.16	20.36	20.51	20.55	20.56	20.56	20.56	20.56	20.50	20.25	19.98

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.72	0.52	0.35	0.25	0.28	0.48	0.78	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	527.72	564.97	578.82	528.03	413.83	275.40	183.09	191.72	299.58	437.41	491.15	508.49	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	758.63	734.38	664.68	547.73	416.06	275.51	183.09	191.73	300.47	465.18	622.56	752.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	171.80	113.84	63.88	14.18	1.66	0.00	0.00	0.00	0.00	20.66	94.62	181.26	

∑(98)1...5, 10...12 = 661.90 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.89 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	661.90		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	694.99	(307a)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1750.10	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.45	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	92.72	(330a)

Total electricity for the above, kWh/year		92.72	(331)
Electricity for lighting (Appendix L)		275.46	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2813.27	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	694.99	x	4.24	x 0.01 =	29.47	(340a)
Water heating from boilers	1750.10	x	4.24	x 0.01 =	74.20	(342a)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	272.24	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.92	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2510.36	x	0.216	=	542.24	(367)
Electrical energy for community heat distribution		24.45	x	0.519	=	12.69	(372)
Total CO2 associated with community systems						554.93	(373)
Total CO2 associated with space and water heating						554.93	(376)
Pumps and fans		92.72	x	0.519	=	48.12	(378)
Electricity for lighting		275.46	x	0.519	=	142.96	(379)
Total CO_2, kg/year					(376)..(382) =	746.01	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.27	(384)
EI value						90.55	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2510.36	x	1.22	=	3062.64	(367)
Electrical energy for community heat distribution		24.45	x	3.07	=	75.06	(372)
Total primary energy associated with community systems						3137.70	(373)
Total primary energy associated with space and water heating						3137.70	(376)
Pumps and fans		92.72	x	3.07	=	284.65	(378)
Electricity for lighting		275.46	x	3.07	=	845.67	(379)
Primary energy kWh/year						4268.02	(383)

Dwelling primary energy rate kWh/m2/year	70.20	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Or 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Roof			30.16	x	0.12	=	3.62			(30)
Total area of external elements ∑A, m²			72.66							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.20 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		10.90 (36)
Total fabric heat loss	(33) + (36) =	35.09 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	48.29	48.13	47.97	47.17	47.01	46.21	46.21	46.05	46.53	47.01	47.33	47.65	
Average = ∑(39)1...12/12 =												47.13	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	0.79	0.79	0.79	0.78	0.77	0.76	0.76	0.76	0.77	0.77	0.78	0.78	
Average = ∑(40)1...12/12 =												0.78	(40)
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.80 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	
∑(44)1...12 =												981.59	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	
∑(45)1...12 =												1287.01	(45)
Distribution loss 0.15 x (45)m													
	20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m													
	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)													
	8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)
Primary circuit loss for each month from Table 3													

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.89	0.74	0.55	0.38	0.27	0.31	0.51	0.81	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.55	20.67	20.83	20.96	20.99	21.00	21.00	21.00	21.00	20.94	20.74	20.52	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.26	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.28	20.28	20.27	20.27	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.94	0.87	0.70	0.51	0.34	0.23	0.26	0.46	0.77	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.67	19.84	20.06	20.23	20.27	20.29	20.29	20.29	20.28	20.22	19.95	19.65	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.01	20.16	20.36	20.51	20.55	20.56	20.56	20.56	20.56	20.50	20.25	19.98	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.01	20.16	20.36	20.51	20.55	20.56	20.56	20.56	20.56	20.50	20.25	19.98	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.72	0.52	0.35	0.25	0.28	0.48	0.78	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	527.72	564.97	578.82	528.03	413.83	275.40	183.09	191.72	299.58	437.41	491.15	508.49	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	758.63	734.38	664.68	547.73	416.06	275.51	183.09	191.73	300.47	465.18	622.56	752.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	171.80	113.84	63.88	14.18	1.66	0.00	0.00	0.00	0.00	20.66	94.62	181.26	

∑(98)1...5, 10...12 = 661.90 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.89 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	661.90		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	139.00	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	555.99	(307b)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	350.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1400.08	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.45	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	92.72	(330a)
Total electricity for the above, kWh/year	92.72	(331)
Electricity for lighting (Appendix L)	275.46	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2813.27	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	139.00	x	2.97	x 0.01 =	4.13	(340a)
Space heating from boilers	555.99	x	4.24	x 0.01 =	23.57	(340b)
Water heating from CHP	350.02	x	2.97	x 0.01 =	10.40	(342a)
Water heating from boilers	1400.08	x	4.24	x 0.01 =	59.36	(342b)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		266.02	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.06	(357)
SAP value	85.27	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	257.1947	x	0.2160	=	55.5541	(363)
less credit emissions for electricity		-85.2752	x	0.5190	=	-44.2578	(364)
Water heated by CHP		647.6555	x	0.2160	=	139.8936	(365)
less credit emissions for electricity		-214.7360	x	0.5190	=	-111.4480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2008.29	x	0.216	=	433.79	(368)
Electrical energy for community heat distribution		24.45	x	0.519	=	12.69	(372)
Total CO2 associated with community systems						486.22	(373)
Total CO2 associated with space and water heating						486.22	(376)
Pumps and fans		92.72	x	0.519	=	48.12	(378)
Electricity for lighting		275.46	x	0.519	=	142.96	(379)
Total CO_2, kg/year					(376)..(382) =	677.31	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.14	(384)
EI value						91.42	
EI rating (section 14)						91	(385)

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EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	257.19	x	1.22	=	313.78	(363)
less credit energy for electricity		-85.28	x	3.07	=	-261.79	(364)
Water heated by CHP		647.66	x	1.22	=	790.14	(365)
less credit energy for electricity		-214.74	x	3.07	=	-659.24	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2008.29	x	1.22	=	2450.11	(368)
Electrical energy for community heat distribution		24.45	x	3.07	=	75.06	(372)
Total primary energy associated with community systems						2708.06	(373)
Total primary energy associated with space and water heating						2708.06	(376)
Pumps and fans		92.72	x	3.07	=	284.65	(378)
Electricity for lighting		275.46	x	3.07	=	845.67	(379)
Primary energy kWh/year						3838.38	(383)
Dwelling primary energy rate kWh/m2/year						63.13	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Or 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		60.80	(1a) x	2.50	(2a) =	152.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	152.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			13.08	x	1.24	=	16.16			(27)
External wall			29.42	x	0.15	=	4.41			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Roof			30.16	x	0.12	=	3.62			(30)
Total area of external elements ∑A, m²			72.66							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.20 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		10.90 (36)
Total fabric heat loss	(33) + (36) =	35.09 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.20	13.04	12.88	12.08	11.92	11.12	11.12	10.96	11.44	11.92	12.24	12.56	(38)

Heat transfer coefficient, W/K (37)m + (38)m

48.29	48.13	47.97	47.17	47.01	46.21	46.21	46.05	46.53	47.01	47.33	47.65	

Average = ∑(39)1...12/12 = 47.13 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.79	0.79	0.79	0.78	0.77	0.76	0.76	0.76	0.77	0.77	0.78	0.78	

Average = ∑(40)1...12/12 = 0.78 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.00 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.80 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
89.98	86.71	83.43	80.16	76.89	73.62	73.62	76.89	80.16	83.43	86.71	89.98	

∑(44)1...12 = 981.59 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.44	116.70	120.43	104.99	100.74	86.93	80.56	92.44	93.54	109.02	119.00	129.23	

∑(45)1...12 = 1287.01 (45)

Distribution loss 0.15 x (45)m

20.02	17.51	18.06	15.75	15.11	13.04	12.08	13.87	14.03	16.35	17.85	19.38	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

165.69	145.84	152.68	136.20	132.99	118.14	112.81	124.69	124.76	141.27	150.21	161.48	

∑(64)1...12 = 1666.76 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.17	62.11	65.84	59.88	59.30	53.87	52.59	56.54	56.07	62.05	64.54	68.77	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	120.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.99	34.63	28.17	21.32	15.94	13.46	14.54	18.90	25.37	32.21	37.60	40.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	261.13	263.84	257.02	242.48	224.13	206.88	195.36	192.65	199.48	214.02	232.37	249.61	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	49.03	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	-80.17	(71)
Water heating gains (Table 5)	94.31	92.42	88.50	83.17	79.70	74.83	70.68	75.99	77.88	83.40	89.63	92.43	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	483.55	480.02	462.79	436.08	408.88	384.28	369.69	376.65	391.84	418.74	448.71	471.23	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.62	x	10.63	x 0.9 x	0.50	x	0.90	=	21.95	(74)
West	0.77	x	6.46	x	19.64	x 0.9 x	0.50	x	0.90	=	39.57	(80)

Solar gains in watts ∑(74)m...(82)m

61.52	119.35	198.75	300.41	382.08	398.35	376.21	313.04	233.96	141.78	76.42	50.84	(83)

Total gains - internal and solar (73)m + (83)m

545.07	599.37	661.55	736.49	790.96	782.63	745.90	689.69	625.80	560.52	525.12	522.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.95	0.89	0.74	0.55	0.38	0.27	0.31	0.51	0.81	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.55	20.67	20.83	20.96	20.99	21.00	21.00	21.00	21.00	20.94	20.74	20.52	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.26	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.28	20.28	20.27	20.27	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.94	0.87	0.70	0.51	0.34	0.23	0.26	0.46	0.77	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.67	19.84	20.06	20.23	20.27	20.29	20.29	20.29	20.28	20.22	19.95	19.65	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.01	20.16	20.36	20.51	20.55	20.56	20.56	20.56	20.56	20.50	20.25	19.98	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.01	20.16	20.36	20.51	20.55	20.56	20.56	20.56	20.56	20.50	20.25	19.98	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.94	0.87	0.72	0.52	0.35	0.25	0.28	0.48	0.78	0.94	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	527.72	564.97	578.82	528.03	413.83	275.40	183.09	191.72	299.58	437.41	491.15	508.49	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	758.63	734.38	664.68	547.73	416.06	275.51	183.09	191.73	300.47	465.18	622.56	752.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	171.80	113.84	63.88	14.18	1.66	0.00	0.00	0.00	0.00	20.66	94.62	181.26	

∑(98)1...5, 10...12 = 661.90 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 10.89 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	661.90		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	139.00	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	555.99	(307b)

Water heating

Annual water heating requirement	1666.76		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	350.02	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1400.08	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	24.45	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	92.72		(330a)
Total electricity for the above, kWh/year		92.72	(331)
Electricity for lighting (Appendix L)		275.46	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2580.10	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	139.00	x	2.97	x 0.01 =	4.13	(340a)
Space heating from boilers	555.99	x	4.24	x 0.01 =	23.57	(340b)
Water heating from CHP	350.02	x	2.97	x 0.01 =	10.40	(342a)
Water heating from boilers	1400.08	x	4.24	x 0.01 =	59.36	(342b)
Pumps and fans	92.72	x	13.19	x 0.01 =	12.23	(349)
Electricity for lighting	275.46	x	13.19	x 0.01 =	36.33	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		266.02	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.06	(357)
SAP value	85.27	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	257.1947	x	0.2160	=	55.5541	(363)
less credit emissions for electricity		-85.2752	x	0.5190	=	-44.2578	(364)
Water heated by CHP		647.6555	x	0.2160	=	139.8936	(365)
less credit emissions for electricity		-214.7360	x	0.5190	=	-111.4480	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2008.29	x	0.216	=	433.79	(368)
Electrical energy for community heat distribution		24.45	x	0.519	=	12.69	(372)
Total CO2 associated with community systems						486.22	(373)
Total CO2 associated with space and water heating						486.22	(376)
Pumps and fans		92.72	x	0.519	=	48.12	(378)
Electricity for lighting		275.46	x	0.519	=	142.96	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	556.29	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.15	(384)
EI value					92.95	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	257.19	x	1.22	=	313.78	(363)
less credit energy for electricity		-85.28	x	3.07	=	-261.79	(364)
Water heated by CHP		647.66	x	1.22	=	790.14	(365)
less credit energy for electricity		-214.74	x	3.07	=	-659.24	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2008.29	x	1.22	=	2450.11	(368)
Electrical energy for community heat distribution		24.45	x	3.07	=	75.06	(372)
Total primary energy associated with community systems						2708.06	(373)
Total primary energy associated with space and water heating						2708.06	(376)
Pumps and fans		92.72	x	3.07	=	284.65	(378)
Electricity for lighting		275.46	x	3.07	=	845.67	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3122.52	(383)
Dwelling primary energy rate kWh/m2/year						51.36	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Po 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		99.40	(1a) x	2.50	(2a) =	248.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	99.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.90	x	1.24	=	25.83			(27)
External wall			56.60	x	0.15	=	8.49			(29a)
Party wall			71.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			77.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.32 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.63 (36)
Total fabric heat loss	(33) + (36) =	45.94 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
21.57	21.31	21.05	19.74	19.48	18.17	18.17	17.91	18.70	19.48	20.00	20.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

67.51	67.25	66.99	65.68	65.42	64.12	64.12	63.85	64.64	65.42	65.95	66.47	

Average = ∑(39)1...12/12 = 65.62 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.68	0.68	0.67	0.66	0.66	0.65	0.65	0.64	0.65	0.66	0.66	0.67	

Average = ∑(40)1...12/12 = 0.66 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.73 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
109.04	105.08	101.11	97.15	93.18	89.22	89.22	93.18	97.15	101.11	105.08	109.04	

∑(44)1...12 = 1189.56 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

161.71	141.43	145.94	127.24	122.09	105.35	97.62	112.03	113.36	132.11	144.21	156.61	

∑(45)1...12 = 1559.70 (45)

Distribution loss 0.15 x (45)m

24.26	21.21	21.89	19.09	18.31	15.80	14.64	16.80	17.00	19.82	21.63	23.49	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	

∑(64)1...12 = 1939.45 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

79.57	70.33	74.33	67.28	66.40	60.00	58.26	63.05	62.66	69.73	72.92	77.87	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.91	50.55	41.11	31.12	23.26	19.64	21.22	27.59	37.03	47.01	54.87	58.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	381.13	385.08	375.11	353.90	327.11	301.94	285.13	281.17	291.14	312.36	339.14	364.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	(71)
Water heating gains (Table 5)	106.95	104.66	99.90	93.44	89.24	83.33	78.31	84.75	87.03	93.72	101.28	104.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	653.80	649.10	624.94	587.27	548.44	513.73	493.47	502.32	524.01	561.91	604.10	636.29	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.38	x	10.63	x 0.9 x	0.50	x	0.90	=	21.16	(74)
East	0.77	x	14.14	x	19.64	x 0.9 x	0.50	x	0.90	=	86.60	(76)
West	0.77	x	0.38	x	19.64	x 0.9 x	0.50	x	0.90	=	2.33	(80)

Solar gains in watts ∑(74)m...(82)m

110.09	214.40	355.21	528.20	660.75	683.36	647.65	546.57	415.82	254.56	136.99	90.77	(83)

Total gains - internal and solar (73)m + (83)m

763.89	863.50	980.15	1115.48	1209.18	1197.09	1141.13	1048.89	939.83	816.46	741.09	727.06	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.88	0.70	0.50	0.34	0.25	0.28	0.47	0.79	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.61	20.74	20.89	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.59

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.36	20.36	20.36	20.38	20.38	20.39	20.39	20.39	20.38	20.38	20.37	20.37

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.86	0.67	0.47	0.31	0.21	0.24	0.43	0.76	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.85	20.03	20.24	20.36	20.38	20.39	20.39	20.39	20.38	20.34	20.11	19.82

(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.09	20.25	20.44	20.56	20.57	20.58	20.58	20.58	20.58	20.54	20.32	20.06

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.09	20.25	20.44	20.56	20.57	20.58	20.58	20.58	20.58	20.54	20.32	20.06

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.86	0.68	0.48	0.32	0.22	0.25	0.45	0.77	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	746.99	819.70	847.54	753.35	579.61	383.47	255.26	267.09	418.38	625.90	701.51	714.75	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1066.05	1032.50	934.00	765.56	580.44	383.49	255.26	267.09	418.70	650.29	871.98	1054.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	237.37	143.01	64.32	8.79	0.62	0.00	0.00	0.00	0.00	18.15	122.74	252.75	

∑(98)1...5, 10...12 = 847.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	847.74		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	890.13	(307a)

Water heating

Annual water heating requirement	1939.45		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	2036.42	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.27	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	162.95	(330a)

Total electricity for the above, kWh/year		162.95	(331)
Electricity for lighting (Appendix L)		402.04	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3491.54	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	890.13	x	4.24	x 0.01 =	37.74	(340a)
Water heating from boilers	2036.42	x	4.24	x 0.01 =	86.34	(342a)
Pumps and fans	162.95	x	13.19	x 0.01 =	21.49	(349)
Electricity for lighting	402.04	x	13.19	x 0.01 =	53.03	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	318.61	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.93	(357)
SAP value	87.07	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3004.67	x	0.216	=	649.01	(367)
Electrical energy for community heat distribution		29.27	x	0.519	=	15.19	(372)
Total CO2 associated with community systems						664.20	(373)
Total CO2 associated with space and water heating						664.20	(376)
Pumps and fans		162.95	x	0.519	=	84.57	(378)
Electricity for lighting		402.04	x	0.519	=	208.66	(379)
Total CO_2, kg/year					(376)..(382) =	957.43	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.63	(384)
EI value						91.12	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3004.67	x	1.22	=	3665.70	(367)
Electrical energy for community heat distribution		29.27	x	3.07	=	89.85	(372)
Total primary energy associated with community systems						3755.55	(373)
Total primary energy associated with space and water heating						3755.55	(376)
Pumps and fans		162.95	x	3.07	=	500.27	(378)
Electricity for lighting		402.04	x	3.07	=	1234.25	(379)
Primary energy kWh/year						5490.07	(383)

Dwelling primary energy rate kWh/m2/year	55.23	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Po 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		99.40	(1a) x	2.50	(2a) =	248.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	99.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.90	x	1.24	=	25.83			(27)
External wall			56.60	x	0.15	=	8.49			(29a)
Party wall			71.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			77.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.32 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.63 (36)
Total fabric heat loss	(33) + (36) =	45.94 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
21.57	21.31	21.05	19.74	19.48	18.17	18.17	17.91	18.70	19.48	20.00	20.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

67.51	67.25	66.99	65.68	65.42	64.12	64.12	63.85	64.64	65.42	65.95	66.47	

Average = ∑(39)1...12/12 = 65.62 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.68	0.68	0.67	0.66	0.66	0.65	0.65	0.64	0.65	0.66	0.66	0.67	

Average = ∑(40)1...12/12 = 0.66 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.73 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
109.04	105.08	101.11	97.15	93.18	89.22	89.22	93.18	97.15	101.11	105.08	109.04	

∑(44)1...12 = 1189.56 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

161.71	141.43	145.94	127.24	122.09	105.35	97.62	112.03	113.36	132.11	144.21	156.61	

∑(45)1...12 = 1559.70 (45)

Distribution loss 0.15 x (45)m

24.26	21.21	21.89	19.09	18.31	15.80	14.64	16.80	17.00	19.82	21.63	23.49	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	

∑(64)1...12 = 1939.45 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

79.57	70.33	74.33	67.28	66.40	60.00	58.26	63.05	62.66	69.73	72.92	77.87	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.91	50.55	41.11	31.12	23.26	19.64	21.22	27.59	37.03	47.01	54.87	58.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	381.13	385.08	375.11	353.90	327.11	301.94	285.13	281.17	291.14	312.36	339.14	364.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	(71)
Water heating gains (Table 5)	106.95	104.66	99.90	93.44	89.24	83.33	78.31	84.75	87.03	93.72	101.28	104.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	653.80	649.10	624.94	587.27	548.44	513.73	493.47	502.32	524.01	561.91	604.10	636.29	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.38	x	10.63	x 0.9 x	0.50	x	0.90	=	21.16	(74)
East	0.77	x	14.14	x	19.64	x 0.9 x	0.50	x	0.90	=	86.60	(76)
West	0.77	x	0.38	x	19.64	x 0.9 x	0.50	x	0.90	=	2.33	(80)

Solar gains in watts ∑(74)m...(82)m

110.09	214.40	355.21	528.20	660.75	683.36	647.65	546.57	415.82	254.56	136.99	90.77	(83)

Total gains - internal and solar (73)m + (83)m

763.89	863.50	980.15	1115.48	1209.18	1197.09	1141.13	1048.89	939.83	816.46	741.09	727.06	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.88	0.70	0.50	0.34	0.25	0.28	0.47	0.79	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.61	20.74	20.89	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.59	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.36	20.36	20.36	20.38	20.38	20.39	20.39	20.39	20.38	20.38	20.37	20.37	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.86	0.67	0.47	0.31	0.21	0.24	0.43	0.76	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.85	20.03	20.24	20.36	20.38	20.39	20.39	20.39	20.38	20.34	20.11	19.82	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.09	20.25	20.44	20.56	20.57	20.58	20.58	20.58	20.58	20.54	20.32	20.06	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.09	20.25	20.44	20.56	20.57	20.58	20.58	20.58	20.58	20.54	20.32	20.06	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.86	0.68	0.48	0.32	0.22	0.25	0.45	0.77	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	746.99	819.70	847.54	753.35	579.61	383.47	255.26	267.09	418.38	625.90	701.51	714.75	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1066.05	1032.50	934.00	765.56	580.44	383.49	255.26	267.09	418.70	650.29	871.98	1054.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	237.37	143.01	64.32	8.79	0.62	0.00	0.00	0.00	0.00	18.15	122.74	252.75	

∑(98)1...5, 10...12 = 847.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	847.74		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	178.03	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	712.10	(307b)

Water heating

Annual water heating requirement	1939.45		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	407.28	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1629.14	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.27	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	162.95		(330a)
Total electricity for the above, kWh/year		162.95	(331)
Electricity for lighting (Appendix L)		402.04	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3491.54	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	178.03	x	2.97	x 0.01 =	5.29	(340a)
Space heating from boilers	712.10	x	4.24	x 0.01 =	30.19	(340b)
Water heating from CHP	407.28	x	2.97	x 0.01 =	12.10	(342a)
Water heating from boilers	1629.14	x	4.24	x 0.01 =	69.08	(342b)
Pumps and fans	162.95	x	13.19	x 0.01 =	21.49	(349)
Electricity for lighting	402.04	x	13.19	x 0.01 =	53.03	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		311.17	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.91	(357)
SAP value	87.37	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	329.4090	x	0.2160	=	71.1523	(363)
less credit emissions for electricity		-109.2185	x	0.5190	=	-56.6844	(364)
Water heated by CHP		753.6148	x	0.2160	=	162.7808	(365)
less credit emissions for electricity		-249.8677	x	0.5190	=	-129.6813	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2403.74	x	0.216	=	519.21	(368)
Electrical energy for community heat distribution		29.27	x	0.519	=	15.19	(372)
Total CO2 associated with community systems						581.96	(373)
Total CO2 associated with space and water heating						581.96	(376)
Pumps and fans		162.95	x	0.519	=	84.57	(378)
Electricity for lighting		402.04	x	0.519	=	208.66	(379)
Total CO_2, kg/year					(376)..(382) =	875.19	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	8.80	(384)
EI value						91.88	
EI rating (section 14)						92	(385)

EI band	A

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	329.41	x	1.22	=	401.88	(363)
less credit energy for electricity		-109.22	x	3.07	=	-335.30	(364)
Water heated by CHP		753.61	x	1.22	=	919.41	(365)
less credit energy for electricity		-249.87	x	3.07	=	-767.09	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2403.74	x	1.22	=	2932.56	(368)
Electrical energy for community heat distribution		29.27	x	3.07	=	89.85	(372)
Total primary energy associated with community systems						3241.30	(373)
Total primary energy associated with space and water heating						3241.30	(376)
Pumps and fans		162.95	x	3.07	=	500.27	(378)
Electricity for lighting		402.04	x	3.07	=	1234.25	(379)
Primary energy kWh/year						4975.82	(383)
Dwelling primary energy rate kWh/m2/year						50.06	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Po 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		99.40	(1a) x	2.50	(2a) =	248.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	99.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.90	x	1.24	=	25.83			(27)
External wall			56.60	x	0.15	=	8.49			(29a)
Party wall			71.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			77.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.32 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.63 (36)
Total fabric heat loss	(33) + (36) =	45.94 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
21.57	21.31	21.05	19.74	19.48	18.17	18.17	17.91	18.70	19.48	20.00	20.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

67.51	67.25	66.99	65.68	65.42	64.12	64.12	63.85	64.64	65.42	65.95	66.47	

Average = ∑(39)1...12/12 = 65.62 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.68	0.68	0.67	0.66	0.66	0.65	0.65	0.64	0.65	0.66	0.66	0.67	

Average = ∑(40)1...12/12 = 0.66 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.73 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
109.04	105.08	101.11	97.15	93.18	89.22	89.22	93.18	97.15	101.11	105.08	109.04	

∑(44)1...12 = 1189.56 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

161.71	141.43	145.94	127.24	122.09	105.35	97.62	112.03	113.36	132.11	144.21	156.61	

∑(45)1...12 = 1559.70 (45)

Distribution loss 0.15 x (45)m

24.26	21.21	21.89	19.09	18.31	15.80	14.64	16.80	17.00	19.82	21.63	23.49	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	

∑(64)1...12 = 1939.45 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

79.57	70.33	74.33	67.28	66.40	60.00	58.26	63.05	62.66	69.73	72.92	77.87	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.91	50.55	41.11	31.12	23.26	19.64	21.22	27.59	37.03	47.01	54.87	58.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	381.13	385.08	375.11	353.90	327.11	301.94	285.13	281.17	291.14	312.36	339.14	364.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	(71)
Water heating gains (Table 5)	106.95	104.66	99.90	93.44	89.24	83.33	78.31	84.75	87.03	93.72	101.28	104.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	653.80	649.10	624.94	587.27	548.44	513.73	493.47	502.32	524.01	561.91	604.10	636.29	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.38	x	10.63	x 0.9 x	0.50	x	0.90	=	21.16	(74)
East	0.77	x	14.14	x	19.64	x 0.9 x	0.50	x	0.90	=	86.60	(76)
West	0.77	x	0.38	x	19.64	x 0.9 x	0.50	x	0.90	=	2.33	(80)

Solar gains in watts ∑(74)m...(82)m

110.09	214.40	355.21	528.20	660.75	683.36	647.65	546.57	415.82	254.56	136.99	90.77	(83)

Total gains - internal and solar (73)m + (83)m

763.89	863.50	980.15	1115.48	1209.18	1197.09	1141.13	1048.89	939.83	816.46	741.09	727.06	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.88	0.70	0.50	0.34	0.25	0.28	0.47	0.79	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.61	20.74	20.89	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.59	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.36	20.36	20.36	20.38	20.38	20.39	20.39	20.39	20.38	20.38	20.37	20.37	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.86	0.67	0.47	0.31	0.21	0.24	0.43	0.76	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.85	20.03	20.24	20.36	20.38	20.39	20.39	20.39	20.38	20.34	20.11	19.82	(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.09	20.25	20.44	20.56	20.57	20.58	20.58	20.58	20.58	20.54	20.32	20.06	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.09	20.25	20.44	20.56	20.57	20.58	20.58	20.58	20.58	20.54	20.32	20.06	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.86	0.68	0.48	0.32	0.22	0.25	0.45	0.77	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	746.99	819.70	847.54	753.35	579.61	383.47	255.26	267.09	418.38	625.90	701.51	714.75	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1066.05	1032.50	934.00	765.56	580.44	383.49	255.26	267.09	418.70	650.29	871.98	1054.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	237.37	143.01	64.32	8.79	0.62	0.00	0.00	0.00	0.00	18.15	122.74	252.75	

∑(98)1...5, 10...12 = 847.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	847.74		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	178.03	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	712.10	(307b)

Water heating

Annual water heating requirement	1939.45		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	407.28	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1629.14	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.27	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	162.95	(330a)
Total electricity for the above, kWh/year	162.95	(331)
Electricity for lighting (Appendix L)	402.04	(332)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-233.18	(333)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3258.37	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	178.03	x	2.97	x 0.01 =	5.29	(340a)
Space heating from boilers	712.10	x	4.24	x 0.01 =	30.19	(340b)
Water heating from CHP	407.28	x	2.97	x 0.01 =	12.10	(342a)
Water heating from boilers	1629.14	x	4.24	x 0.01 =	69.08	(342b)
Pumps and fans	162.95	x	13.19	x 0.01 =	21.49	(349)
Electricity for lighting	402.04	x	13.19	x 0.01 =	53.03	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		311.17	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.91	(357)
SAP value	87.37	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	329.4090	x	0.2160	=	71.1523	(363)
less credit emissions for electricity		-109.2185	x	0.5190	=	-56.6844	(364)
Water heated by CHP		753.6148	x	0.2160	=	162.7808	(365)
less credit emissions for electricity		-249.8677	x	0.5190	=	-129.6813	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2403.74	x	0.216	=	519.21	(368)
Electrical energy for community heat distribution		29.27	x	0.519	=	15.19	(372)
Total CO2 associated with community systems						581.96	(373)
Total CO2 associated with space and water heating						581.96	(376)
Pumps and fans		162.95	x	0.519	=	84.57	(378)
Electricity for lighting		402.04	x	0.519	=	208.66	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	754.18	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.59	(384)
EI value					93.00	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	329.41	x	1.22	=	401.88	(363)
less credit energy for electricity		-109.22	x	3.07	=	-335.30	(364)
Water heated by CHP		753.61	x	1.22	=	919.41	(365)
less credit energy for electricity		-249.87	x	3.07	=	-767.09	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2403.74	x	1.22	=	2932.56	(368)
Electrical energy for community heat distribution		29.27	x	3.07	=	89.85	(372)
Total primary energy associated with community systems						3241.30	(373)
Total primary energy associated with space and water heating						3241.30	(376)
Pumps and fans		162.95	x	3.07	=	500.27	(378)
Electricity for lighting		402.04	x	3.07	=	1234.25	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						4259.97	(383)
Dwelling primary energy rate kWh/m2/year						42.86	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Pr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		99.40	(1a) x	2.50	(2a) =	248.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	99.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.90	x	1.24	=	25.83			(27)
External wall			56.60	x	0.15	=	8.49			(29a)
Party wall			71.25	x	0.00	=	0.00			(32)
Roof			61.50	x	0.12	=	7.38			(30)
Total area of external elements ∑A, m²			139.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.70 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.85 (36)
Total fabric heat loss	(33) + (36) =	62.55 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
21.57	21.31	21.05	19.74	19.48	18.17	18.17	17.91	18.70	19.48	20.00	20.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

84.12	83.86	83.60	82.29	82.03	80.72	80.72	80.46	81.24	82.03	82.55	83.07	

Average = ∑(39)1...12/12 = 82.22 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.84	0.84	0.83	0.83	0.81	0.81	0.81	0.82	0.83	0.83	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.73 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
109.04	105.08	101.11	97.15	93.18	89.22	89.22	93.18	97.15	101.11	105.08	109.04	

∑(44)1...12 = 1189.56 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

161.71	141.43	145.94	127.24	122.09	105.35	97.62	112.03	113.36	132.11	144.21	156.61	

∑(45)1...12 = 1559.70 (45)

Distribution loss 0.15 x (45)m

24.26	21.21	21.89	19.09	18.31	15.80	14.64	16.80	17.00	19.82	21.63	23.49	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	

∑(64)1...12 = 1939.45 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

79.57	70.33	74.33	67.28	66.40	60.00	58.26	63.05	62.66	69.73	72.92	77.87	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.91	50.55	41.11	31.12	23.26	19.64	21.22	27.59	37.03	47.01	54.87	58.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	381.13	385.08	375.11	353.90	327.11	301.94	285.13	281.17	291.14	312.36	339.14	364.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	(71)
Water heating gains (Table 5)	106.95	104.66	99.90	93.44	89.24	83.33	78.31	84.75	87.03	93.72	101.28	104.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	653.80	649.10	624.94	587.27	548.44	513.73	493.47	502.32	524.01	561.91	604.10	636.29	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.38	x	10.63	x 0.9 x	0.50	x	0.90	=	21.16	(74)
East	0.77	x	14.14	x	19.64	x 0.9 x	0.50	x	0.90	=	86.60	(76)
West	0.77	x	0.38	x	19.64	x 0.9 x	0.50	x	0.90	=	2.33	(80)

Solar gains in watts ∑(74)m...(82)m

110.09	214.40	355.21	528.20	660.75	683.36	647.65	546.57	415.82	254.56	136.99	90.77	(83)

Total gains - internal and solar (73)m + (83)m

763.89	863.50	980.15	1115.48	1209.18	1197.09	1141.13	1048.89	939.83	816.46	741.09	727.06	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.98	0.94	0.81	0.62	0.43	0.31	0.35	0.59	0.89	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.35	20.50	20.71	20.91	20.99	21.00	21.00	21.00	20.99	20.87	20.58	20.33

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.21	20.22	20.22	20.23	20.23	20.24	20.24	20.25	20.24	20.23	20.23	20.22

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.92	0.78	0.57	0.38	0.26	0.29	0.53	0.85	0.97	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.36	19.57	19.86	20.14	20.22	20.24	20.24	20.25	20.23	20.09	19.69	19.33

(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.67	19.86	20.13	20.38	20.46	20.48	20.48	20.48	20.47	20.34	19.97	19.64

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.67	19.86	20.13	20.38	20.46	20.48	20.48	20.48	20.47	20.34	19.97	19.64

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.99	0.97	0.92	0.79	0.59	0.40	0.27	0.31	0.55	0.86	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	753.31	838.08	904.14	877.22	709.06	474.04	313.20	328.34	513.24	701.27	718.64	719.26	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1292.95	1254.30	1139.40	944.68	718.59	474.62	313.24	328.43	517.65	798.82	1062.51	1282.65	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	401.50	279.70	175.03	48.58	7.09	0.00	0.00	0.00	0.00	72.57	247.59	419.17	

∑(98)1...5, 10...12 = 1651.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.61 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1651.22		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1733.78	(307a)

Water heating

Annual water heating requirement	1939.45		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	2036.42	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	37.70	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	162.95		(330a)
Total electricity for the above, kWh/year		162.95	(331)
Electricity for lighting (Appendix L)		402.04	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4335.20	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1733.78	x	4.24	x 0.01 =	73.51	(340a)
Water heating from boilers	2036.42	x	4.24	x 0.01 =	86.34	(342a)
Pumps and fans	162.95	x	13.19	x 0.01 =	21.49	(349)
Electricity for lighting	402.04	x	13.19	x 0.01 =	53.03	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		354.38	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.62	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3870.85	x	0.216	=	836.10	(367)
Electrical energy for community heat distribution	37.70	x	0.519	=	19.57	(372)
Total CO2 associated with community systems					855.67	(373)
Total CO2 associated with space and water heating					855.67	(376)
Pumps and fans	162.95	x	0.519	=	84.57	(378)
Electricity for lighting	402.04	x	0.519	=	208.66	(379)
Total CO_2, kg/year				(376)..(382) =	1148.90	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.56	(384)
EI value					89.34	
EI rating (section 14)					89	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3870.85	x	1.22	=	4722.43	(367)
Electrical energy for community heat distribution	37.70	x	3.07	=	115.75	(372)
Total primary energy associated with community systems					4838.18	(373)
Total primary energy associated with space and water heating					4838.18	(376)
Pumps and fans	162.95	x	3.07	=	500.27	(378)
Electricity for lighting	402.04	x	3.07	=	1234.25	(379)

Primary energy kWh/year	6572.70	(383)
Dwelling primary energy rate kWh/m2/year	66.12	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Pr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		99.40	(1a) x	2.50	(2a) =	248.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	99.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.90	x	1.24	=	25.83			(27)
External wall			56.60	x	0.15	=	8.49			(29a)
Party wall			71.25	x	0.00	=	0.00			(32)
Roof			61.50	x	0.12	=	7.38			(30)
Total area of external elements ∑A, m²			139.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.70 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.85 (36)
Total fabric heat loss	(33) + (36) =	62.55 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
21.57	21.31	21.05	19.74	19.48	18.17	18.17	17.91	18.70	19.48	20.00	20.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

84.12	83.86	83.60	82.29	82.03	80.72	80.72	80.46	81.24	82.03	82.55	83.07	

Average = ∑(39)1...12/12 = 82.22 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.84	0.84	0.83	0.83	0.81	0.81	0.81	0.82	0.83	0.83	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.73 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
109.04	105.08	101.11	97.15	93.18	89.22	89.22	93.18	97.15	101.11	105.08	109.04	

∑(44)1...12 = 1189.56 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

161.71	141.43	145.94	127.24	122.09	105.35	97.62	112.03	113.36	132.11	144.21	156.61	

∑(45)1...12 = 1559.70 (45)

Distribution loss 0.15 x (45)m

24.26	21.21	21.89	19.09	18.31	15.80	14.64	16.80	17.00	19.82	21.63	23.49	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	

∑(64)1...12 = 1939.45 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

79.57	70.33	74.33	67.28	66.40	60.00	58.26	63.05	62.66	69.73	72.92	77.87	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.91	50.55	41.11	31.12	23.26	19.64	21.22	27.59	37.03	47.01	54.87	58.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	381.13	385.08	375.11	353.90	327.11	301.94	285.13	281.17	291.14	312.36	339.14	364.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	(71)
Water heating gains (Table 5)	106.95	104.66	99.90	93.44	89.24	83.33	78.31	84.75	87.03	93.72	101.28	104.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	653.80	649.10	624.94	587.27	548.44	513.73	493.47	502.32	524.01	561.91	604.10	636.29	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.38	x	10.63	x 0.9 x	0.50	x	0.90	=	21.16	(74)
East	0.77	x	14.14	x	19.64	x 0.9 x	0.50	x	0.90	=	86.60	(76)
West	0.77	x	0.38	x	19.64	x 0.9 x	0.50	x	0.90	=	2.33	(80)

Solar gains in watts ∑(74)m...(82)m

110.09	214.40	355.21	528.20	660.75	683.36	647.65	546.57	415.82	254.56	136.99	90.77	(83)

Total gains - internal and solar (73)m + (83)m

763.89	863.50	980.15	1115.48	1209.18	1197.09	1141.13	1048.89	939.83	816.46	741.09	727.06	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.98	0.94	0.81	0.62	0.43	0.31	0.35	0.59	0.89	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.35	20.50	20.71	20.91	20.99	21.00	21.00	21.00	20.99	20.87	20.58	20.33

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.21	20.22	20.22	20.23	20.23	20.24	20.24	20.25	20.24	20.23	20.23	20.22

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.92	0.78	0.57	0.38	0.26	0.29	0.53	0.85	0.97	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.36	19.57	19.86	20.14	20.22	20.24	20.24	20.25	20.23	20.09	19.69	19.33

(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.67	19.86	20.13	20.38	20.46	20.48	20.48	20.48	20.47	20.34	19.97	19.64

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.67	19.86	20.13	20.38	20.46	20.48	20.48	20.48	20.47	20.34	19.97	19.64

(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains, ηm

0.99	0.97	0.92	0.79	0.59	0.40	0.27	0.31	0.55	0.86	0.97	0.99

(94)

Useful gains, ηmGm, W (94)m x (84)m

753.31	838.08	904.14	877.22	709.06	474.04	313.20	328.34	513.24	701.27	718.64	719.26

(95)

Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20

(96)

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1292.95	1254.30	1139.40	944.68	718.59	474.62	313.24	328.43	517.65	798.82	1062.51	1282.65

(97)

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

401.50	279.70	175.03	48.58	7.09	0.00	0.00	0.00	0.00	72.57	247.59	419.17

∑(98)1...5, 10...12 = 1651.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.61 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1651.22		(98)
Space heat from CHP		(98) x (304a) x (305) x (306) = 346.76	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) = 1387.03	(307b)

Water heating

Annual water heating requirement	1939.45		(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) = 407.28	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1629.14	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	37.70	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	162.95	(330a)
Total electricity for the above, kWh/year	162.95	(331)
Electricity for lighting (Appendix L)	402.04	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4335.20	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	346.76	x	2.97	x 0.01 =	10.30	(340a)
Space heating from boilers	1387.03	x	4.24	x 0.01 =	58.81	(340b)
Water heating from CHP	407.28	x	2.97	x 0.01 =	12.10	(342a)
Water heating from boilers	1629.14	x	4.24	x 0.01 =	69.08	(342b)
Pumps and fans	162.95	x	13.19	x 0.01 =	21.49	(349)
Electricity for lighting	402.04	x	13.19	x 0.01 =	53.03	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		344.80	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	86.01	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	641.6178	x	0.2160	=	138.5894	(363)
less credit emissions for electricity		-212.7341	x	0.5190	=	-110.4090	(364)
Water heated by CHP		753.6148	x	0.2160	=	162.7808	(365)
less credit emissions for electricity		-249.8677	x	0.5190	=	-129.6813	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3096.68	x	0.216	=	668.88	(368)
Electrical energy for community heat distribution		37.70	x	0.519	=	19.57	(372)
Total CO2 associated with community systems						749.73	(373)
Total CO2 associated with space and water heating						749.73	(376)
Pumps and fans		162.95	x	0.519	=	84.57	(378)
Electricity for lighting		402.04	x	0.519	=	208.66	(379)
Total CO_2, kg/year					(376)..(382) =	1042.96	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.49	(384)
EI value						90.32	

EI rating (section 14)	90	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	641.62	x	1.22	=	782.77	(363)
less credit energy for electricity		-212.73	x	3.07	=	-653.09	(364)
Water heated by CHP		753.61	x	1.22	=	919.41	(365)
less credit energy for electricity		-249.87	x	3.07	=	-767.09	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3096.68	x	1.22	=	3777.95	(368)
Electrical energy for community heat distribution		37.70	x	3.07	=	115.75	(372)
Total primary energy associated with community systems						4175.69	(373)
Total primary energy associated with space and water heating						4175.69	(376)
Pumps and fans		162.95	x	3.07	=	500.27	(378)
Electricity for lighting		402.04	x	3.07	=	1234.25	(379)
Primary energy kWh/year						5910.21	(383)
Dwelling primary energy rate kWh/m2/year						59.46	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Pr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		99.40	(1a) x	2.50	(2a) =	248.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	99.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.90	x	1.24	=	25.83			(27)
External wall			56.60	x	0.15	=	8.49			(29a)
Party wall			71.25	x	0.00	=	0.00			(32)
Roof			61.50	x	0.12	=	7.38			(30)
Total area of external elements ∑A, m²			139.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.70 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.85 (36)
Total fabric heat loss	(33) + (36) =	62.55 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
21.57	21.31	21.05	19.74	19.48	18.17	18.17	17.91	18.70	19.48	20.00	20.53	(38)

Heat transfer coefficient, W/K (37)m + (38)m

84.12	83.86	83.60	82.29	82.03	80.72	80.72	80.46	81.24	82.03	82.55	83.07	

Average = ∑(39)1...12/12 = 82.22 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.85	0.84	0.84	0.83	0.83	0.81	0.81	0.81	0.82	0.83	0.83	0.84	

Average = ∑(40)1...12/12 = 0.83 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.73 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.13 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
109.04	105.08	101.11	97.15	93.18	89.22	89.22	93.18	97.15	101.11	105.08	109.04	

∑(44)1...12 = 1189.56 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

161.71	141.43	145.94	127.24	122.09	105.35	97.62	112.03	113.36	132.11	144.21	156.61	

∑(45)1...12 = 1559.70 (45)

Distribution loss 0.15 x (45)m

24.26	21.21	21.89	19.09	18.31	15.80	14.64	16.80	17.00	19.82	21.63	23.49	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

193.96	170.56	178.20	158.45	154.34	136.56	129.88	144.28	144.58	164.37	175.42	188.86	

∑(64)1...12 = 1939.45 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

79.57	70.33	74.33	67.28	66.40	60.00	58.26	63.05	62.66	69.73	72.92	77.87	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	164.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.91	50.55	41.11	31.12	23.26	19.64	21.22	27.59	37.03	47.01	54.87	58.49	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	381.13	385.08	375.11	353.90	327.11	301.94	285.13	281.17	291.14	312.36	339.14	364.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	54.14	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	-109.36	(71)
Water heating gains (Table 5)	106.95	104.66	99.90	93.44	89.24	83.33	78.31	84.75	87.03	93.72	101.28	104.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	653.80	649.10	624.94	587.27	548.44	513.73	493.47	502.32	524.01	561.91	604.10	636.29	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	6.38	x	10.63	x 0.9 x	0.50	x	0.90	=	21.16	(74)
East	0.77	x	14.14	x	19.64	x 0.9 x	0.50	x	0.90	=	86.60	(76)
West	0.77	x	0.38	x	19.64	x 0.9 x	0.50	x	0.90	=	2.33	(80)

Solar gains in watts ∑(74)m...(82)m

110.09	214.40	355.21	528.20	660.75	683.36	647.65	546.57	415.82	254.56	136.99	90.77	(83)

Total gains - internal and solar (73)m + (83)m

763.89	863.50	980.15	1115.48	1209.18	1197.09	1141.13	1048.89	939.83	816.46	741.09	727.06	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.98	0.94	0.81	0.62	0.43	0.31	0.35	0.59	0.89	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.35	20.50	20.71	20.91	20.99	21.00	21.00	21.00	20.99	20.87	20.58	20.33

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.21	20.22	20.22	20.23	20.23	20.24	20.24	20.25	20.24	20.23	20.23	20.22

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.92	0.78	0.57	0.38	0.26	0.29	0.53	0.85	0.97	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.36	19.57	19.86	20.14	20.22	20.24	20.24	20.25	20.23	20.09	19.69	19.33

(90)

Living area fraction — Living area ÷ (4) = 0.31 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.67	19.86	20.13	20.38	20.46	20.48	20.48	20.48	20.47	20.34	19.97	19.64

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.67	19.86	20.13	20.38	20.46	20.48	20.48	20.48	20.47	20.34	19.97	19.64

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.97	0.92	0.79	0.59	0.40	0.27	0.31	0.55	0.86	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	753.31	838.08	904.14	877.22	709.06	474.04	313.20	328.34	513.24	701.27	718.64	719.26	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1292.95	1254.30	1139.40	944.68	718.59	474.62	313.24	328.43	517.65	798.82	1062.51	1282.65	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	401.50	279.70	175.03	48.58	7.09	0.00	0.00	0.00	0.00	72.57	247.59	419.17	

∑(98)1...5, 10...12 = 1651.22 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.61 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1651.22		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	346.76	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1387.03	(307b)

Water heating

Annual water heating requirement	1939.45		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	407.28	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1629.14	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	37.70	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	162.95		(330a)
Total electricity for the above, kWh/year		162.95	(331)
Electricity for lighting (Appendix L)		402.04	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4102.02	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	346.76	x	2.97	x 0.01 =	10.30	(340a)
Space heating from boilers	1387.03	x	4.24	x 0.01 =	58.81	(340b)
Water heating from CHP	407.28	x	2.97	x 0.01 =	12.10	(342a)
Water heating from boilers	1629.14	x	4.24	x 0.01 =	69.08	(342b)
Pumps and fans	162.95	x	13.19	x 0.01 =	21.49	(349)
Electricity for lighting	402.04	x	13.19	x 0.01 =	53.03	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		344.80	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	86.01	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	641.6178	x	0.2160	=	138.5894	(363)
less credit emissions for electricity		-212.7341	x	0.5190	=	-110.4090	(364)
Water heated by CHP		753.6148	x	0.2160	=	162.7808	(365)
less credit emissions for electricity		-249.8677	x	0.5190	=	-129.6813	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3096.68	x	0.216	=	668.88	(368)
Electrical energy for community heat distribution		37.70	x	0.519	=	19.57	(372)
Total CO2 associated with community systems						749.73	(373)
Total CO2 associated with space and water heating						749.73	(376)
Pumps and fans		162.95	x	0.519	=	84.57	(378)

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Electricity for lighting	402.04	x	0.519	=	208.66	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	921.94	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.28	(384)
EI value					91.44	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	641.62	x	1.22	=	782.77	(363)
less credit energy for electricity		-212.73	x	3.07	=	-653.09	(364)
Water heated by CHP		753.61	x	1.22	=	919.41	(365)
less credit energy for electricity		-249.87	x	3.07	=	-767.09	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3096.68	x	1.22	=	3777.95	(368)
Electrical energy for community heat distribution		37.70	x	3.07	=	115.75	(372)
Total primary energy associated with community systems						4175.69	(373)
Total primary energy associated with space and water heating						4175.69	(376)
Pumps and fans		162.95	x	3.07	=	500.27	(378)
Electricity for lighting		402.04	x	3.07	=	1234.25	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						5194.36	(383)
Dwelling primary energy rate kWh/m2/year						52.26	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Qo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.20	(1a) x	2.50	(2a) =	198.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	198.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.01	x	1.24	=	24.73			(27)
External wall			49.99	x	0.15	=	7.50			(29a)
Party wall			33.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			70.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.23 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		10.50 (36)
Total fabric heat loss	(33) + (36) =	42.73 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.19	16.98	16.77	15.73	15.52	14.48	14.48	14.27	14.90	15.52	15.94	16.36	(38)

Heat transfer coefficient, W/K (37)m + (38)m

59.91	59.71	59.50	58.46	58.25	57.21	57.21	57.00	57.62	58.25	58.66	59.08	

Average = ∑(39)1...12/12 = 58.40 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.76	0.75	0.75	0.74	0.74	0.72	0.72	0.72	0.73	0.74	0.74	0.75	

Average = ∑(40)1...12/12 = 0.74 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.45 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.33 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.56	97.87	94.17	90.48	86.79	83.10	83.10	86.79	90.48	94.17	97.87	101.56	

∑(44)1...12 = 1107.94 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.61	131.73	135.93	118.51	113.71	98.12	90.93	104.34	105.58	123.05	134.32	145.86	

∑(45)1...12 = 1452.68 (45)

Distribution loss 0.15 x (45)m

22.59	19.76	20.39	17.78	17.06	14.72	13.64	15.65	15.84	18.46	20.15	21.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	

∑(64)1...12 = 1832.43 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.88	67.10	71.00	64.37	63.61	57.60	56.03	60.49	60.08	66.72	69.63	74.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.53	43.11	35.06	26.54	19.84	16.75	18.10	23.52	31.57	40.09	46.79	49.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	325.02	328.39	319.89	301.80	278.96	257.49	243.15	239.78	248.28	266.37	289.21	310.68	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	(71)
Water heating gains (Table 5)	101.99	99.86	95.43	89.41	85.50	79.99	75.32	81.31	83.44	89.67	96.71	99.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	576.62	572.44	551.46	518.83	485.38	455.32	437.65	445.69	464.37	497.22	533.79	561.51	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.24	x	36.79	x 0.9 x	0.50	x	0.90	=	140.44	(79)
NorthWest	0.77	x	7.33	x	11.28	x 0.9 x	0.50	x	0.90	=	25.79	(81)
NorthEast	0.77	x	0.44	x	11.28	x 0.9 x	0.50	x	0.90	=	1.55	(75)

Solar gains in watts ∑(74)m...(82)m

167.78	294.88	427.59	570.23	675.61	686.95	655.54	574.44	476.59	332.41	202.62	142.52	(83)

Total gains - internal and solar (73)m + (83)m

744.40	867.31	979.04	1089.06	1160.98	1142.27	1093.19	1020.14	940.97	829.62	736.41	704.02	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.82	0.64	0.47	0.32	0.23	0.26	0.42	0.71	0.92	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.64	20.79	20.92	20.99	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.61	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.29	20.29	20.30	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.31	20.30	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.90	0.79	0.61	0.43	0.29	0.19	0.22	0.38	0.67	0.90	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.83	20.04	20.20	20.29	20.31	20.32	20.32	20.32	20.32	20.29	20.09	19.79	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.10	20.29	20.44	20.53	20.54	20.55	20.55	20.55	20.55	20.52	20.34	20.07	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.10	20.29	20.44	20.53	20.54	20.55	20.55	20.55	20.55	20.52	20.34	20.07	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.90	0.79	0.62	0.44	0.30	0.21	0.23	0.39	0.68	0.90	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	710.95	781.38	777.44	671.16	514.16	340.30	225.92	236.58	371.18	564.61	663.39	679.41	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	946.86	918.79	829.60	679.61	514.93	340.33	225.92	236.58	371.42	577.79	776.66	937.45	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	175.51	92.34	38.81	6.09	0.57	0.00	0.00	0.00	0.00	9.81	81.55	191.98	

∑(98)1...5, 10...12 = 596.66 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 7.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	596.66		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	626.49	(307a)

Water heating

Annual water heating requirement	1832.43		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1924.05	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.51	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	129.84	(330a)

Total electricity for the above, kWh/year		129.84	(331)
Electricity for lighting (Appendix L)		342.85	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3023.23	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	626.49	x	4.24	x 0.01 =	26.56	(340a)
Water heating from boilers	1924.05	x	4.24	x 0.01 =	81.58	(342a)
Pumps and fans	129.84	x	13.19	x 0.01 =	17.13	(349)
Electricity for lighting	342.85	x	13.19	x 0.01 =	45.22	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		290.49	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.98	(357)
SAP value	86.30	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2618.63	x	0.216	=	565.62	(367)
Electrical energy for community heat distribution		25.51	x	0.519	=	13.24	(372)
Total CO2 associated with community systems						578.86	(373)
Total CO2 associated with space and water heating						578.86	(376)
Pumps and fans		129.84	x	0.519	=	67.39	(378)
Electricity for lighting		342.85	x	0.519	=	177.94	(379)
Total CO_2, kg/year					(376)..(382) =	824.19	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.41	(384)
EI value						91.11	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2618.63	x	1.22	=	3194.73	(367)
Electrical energy for community heat distribution		25.51	x	3.07	=	78.30	(372)
Total primary energy associated with community systems						3273.03	(373)
Total primary energy associated with space and water heating						3273.03	(376)
Pumps and fans		129.84	x	3.07	=	398.60	(378)
Electricity for lighting		342.85	x	3.07	=	1052.54	(379)
Primary energy kWh/year						4724.18	(383)

Dwelling primary energy rate kWh/m2/year	59.65	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Qo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.20	(1a) x	2.50	(2a) =	198.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	198.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.01	x	1.24	=	24.73			(27)
External wall			49.99	x	0.15	=	7.50			(29a)
Party wall			33.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			70.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.23 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		10.50 (36)
Total fabric heat loss	(33) + (36) =	42.73 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.19	16.98	16.77	15.73	15.52	14.48	14.48	14.27	14.90	15.52	15.94	16.36	(38)

Heat transfer coefficient, W/K (37)m + (38)m

59.91	59.71	59.50	58.46	58.25	57.21	57.21	57.00	57.62	58.25	58.66	59.08	

Average = ∑(39)1...12/12 = 58.40 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.76	0.75	0.75	0.74	0.74	0.72	0.72	0.72	0.73	0.74	0.74	0.75	

Average = ∑(40)1...12/12 = 0.74 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.45 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.33 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.56	97.87	94.17	90.48	86.79	83.10	83.10	86.79	90.48	94.17	97.87	101.56	

∑(44)1...12 = 1107.94 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.61	131.73	135.93	118.51	113.71	98.12	90.93	104.34	105.58	123.05	134.32	145.86	

∑(45)1...12 = 1452.68 (45)

Distribution loss 0.15 x (45)m

22.59	19.76	20.39	17.78	17.06	14.72	13.64	15.65	15.84	18.46	20.15	21.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	

∑(64)1...12 = 1832.43 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.88	67.10	71.00	64.37	63.61	57.60	56.03	60.49	60.08	66.72	69.63	74.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.53	43.11	35.06	26.54	19.84	16.75	18.10	23.52	31.57	40.09	46.79	49.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	325.02	328.39	319.89	301.80	278.96	257.49	243.15	239.78	248.28	266.37	289.21	310.68	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	(71)
Water heating gains (Table 5)	101.99	99.86	95.43	89.41	85.50	79.99	75.32	81.31	83.44	89.67	96.71	99.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	576.62	572.44	551.46	518.83	485.38	455.32	437.65	445.69	464.37	497.22	533.79	561.51	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.24	x	36.79	x 0.9 x	0.50	x	0.90	=	140.44	(79)
NorthWest	0.77	x	7.33	x	11.28	x 0.9 x	0.50	x	0.90	=	25.79	(81)
NorthEast	0.77	x	0.44	x	11.28	x 0.9 x	0.50	x	0.90	=	1.55	(75)

Solar gains in watts ∑(74)m...(82)m

167.78	294.88	427.59	570.23	675.61	686.95	655.54	574.44	476.59	332.41	202.62	142.52	(83)

Total gains - internal and solar (73)m + (83)m

744.40	867.31	979.04	1089.06	1160.98	1142.27	1093.19	1020.14	940.97	829.62	736.41	704.02	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.82	0.64	0.47	0.32	0.23	0.26	0.42	0.71	0.92	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.64	20.79	20.92	20.99	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.61	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.29	20.29	20.30	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.31	20.30	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.90	0.79	0.61	0.43	0.29	0.19	0.22	0.38	0.67	0.90	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.83	20.04	20.20	20.29	20.31	20.32	20.32	20.32	20.32	20.29	20.09	19.79	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.10	20.29	20.44	20.53	20.54	20.55	20.55	20.55	20.55	20.52	20.34	20.07	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.10	20.29	20.44	20.53	20.54	20.55	20.55	20.55	20.55	20.52	20.34	20.07	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.90	0.79	0.62	0.44	0.30	0.21	0.23	0.39	0.68	0.90	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	710.95	781.38	777.44	671.16	514.16	340.30	225.92	236.58	371.18	564.61	663.39	679.41	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	946.86	918.79	829.60	679.61	514.93	340.33	225.92	236.58	371.42	577.79	776.66	937.45	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	175.51	92.34	38.81	6.09	0.57	0.00	0.00	0.00	0.00	9.81	81.55	191.98	

∑(98)1...5, 10...12 = 596.66 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 7.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	596.66		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	125.30	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	501.19	(307b)

Water heating

Annual water heating requirement	1832.43		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	384.81	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1539.24	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.51	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	129.84		(330a)
Total electricity for the above, kWh/year		129.84	(331)
Electricity for lighting (Appendix L)		342.85	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3023.23	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	125.30	x	2.97	x 0.01 =	3.72	(340a)
Space heating from boilers	501.19	x	4.24	x 0.01 =	21.25	(340b)
Water heating from CHP	384.81	x	2.97	x 0.01 =	11.43	(342a)
Water heating from boilers	1539.24	x	4.24	x 0.01 =	65.26	(342b)
Pumps and fans	129.84	x	13.19	x 0.01 =	17.13	(349)
Electricity for lighting	342.85	x	13.19	x 0.01 =	45.22	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		284.01	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.60	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	231.8448	x	0.2160	=	50.0785	(363)
less credit emissions for electricity		-76.8702	x	0.5190	=	-39.8956	(364)
Water heated by CHP		712.0298	x	0.2160	=	153.7984	(365)
less credit emissions for electricity		-236.0799	x	0.5190	=	-122.5254	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2094.90	x	0.216	=	452.50	(368)
Electrical energy for community heat distribution		25.51	x	0.519	=	13.24	(372)
Total CO2 associated with community systems						507.19	(373)
Total CO2 associated with space and water heating						507.19	(376)
Pumps and fans		129.84	x	0.519	=	67.39	(378)
Electricity for lighting		342.85	x	0.519	=	177.94	(379)
Total CO_2, kg/year					(376)..(382) =	752.52	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	9.50	(384)
EI value						91.88	
EI rating (section 14)						92	(385)

EI band | A

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	231.84	x	1.22	=	282.85	(363)
less credit energy for electricity		-76.87	x	3.07	=	-235.99	(364)
Water heated by CHP		712.03	x	1.22	=	868.68	(365)
less credit energy for electricity		-236.08	x	3.07	=	-724.77	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2094.90	x	1.22	=	2555.78	(368)
Electrical energy for community heat distribution		25.51	x	3.07	=	78.30	(372)
Total primary energy associated with community systems						2824.85	(373)
Total primary energy associated with space and water heating						2824.85	(376)
Pumps and fans		129.84	x	3.07	=	398.60	(378)
Electricity for lighting		342.85	x	3.07	=	1052.54	(379)
Primary energy kWh/year						4276.00	(383)
Dwelling primary energy rate kWh/m2/year						53.99	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Qo 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.20	(1a) x	2.50	(2a) =	198.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	198.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.01	x	1.24	=	24.73			(27)
External wall			49.99	x	0.15	=	7.50			(29a)
Party wall			33.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			70.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	32.23 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		10.50 (36)
Total fabric heat loss	(33) + (36) =	42.73 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.19	16.98	16.77	15.73	15.52	14.48	14.48	14.27	14.90	15.52	15.94	16.36	(38)

Heat transfer coefficient, W/K (37)m + (38)m

59.91	59.71	59.50	58.46	58.25	57.21	57.21	57.00	57.62	58.25	58.66	59.08	

Average = ∑(39)1...12/12 = 58.40 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.76	0.75	0.75	0.74	0.74	0.72	0.72	0.72	0.73	0.74	0.74	0.75	

Average = ∑(40)1...12/12 = 0.74 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.45 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.33 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.56	97.87	94.17	90.48	86.79	83.10	83.10	86.79	90.48	94.17	97.87	101.56	

∑(44)1...12 = 1107.94 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.61	131.73	135.93	118.51	113.71	98.12	90.93	104.34	105.58	123.05	134.32	145.86	

∑(45)1...12 = 1452.68 (45)

Distribution loss 0.15 x (45)m

22.59	19.76	20.39	17.78	17.06	14.72	13.64	15.65	15.84	18.46	20.15	21.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	

∑(64)1...12 = 1832.43 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.88	67.10	71.00	64.37	63.61	57.60	56.03	60.49	60.08	66.72	69.63	74.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.53	43.11	35.06	26.54	19.84	16.75	18.10	23.52	31.57	40.09	46.79	49.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	325.02	328.39	319.89	301.80	278.96	257.49	243.15	239.78	248.28	266.37	289.21	310.68	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	(71)
Water heating gains (Table 5)	101.99	99.86	95.43	89.41	85.50	79.99	75.32	81.31	83.44	89.67	96.71	99.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	576.62	572.44	551.46	518.83	485.38	455.32	437.65	445.69	464.37	497.22	533.79	561.51	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.24	x	36.79	x 0.9 x	0.50	x	0.90	=	140.44	(79)
NorthWest	0.77	x	7.33	x	11.28	x 0.9 x	0.50	x	0.90	=	25.79	(81)
NorthEast	0.77	x	0.44	x	11.28	x 0.9 x	0.50	x	0.90	=	1.55	(75)

Solar gains in watts ∑(74)m...(82)m

167.78	294.88	427.59	570.23	675.61	686.95	655.54	574.44	476.59	332.41	202.62	142.52	(83)

Total gains - internal and solar (73)m + (83)m

744.40	867.31	979.04	1089.06	1160.98	1142.27	1093.19	1020.14	940.97	829.62	736.41	704.02	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.92	0.82	0.64	0.47	0.32	0.23	0.26	0.42	0.71	0.92	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.64	20.79	20.92	20.99	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.61	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.29	20.29	20.30	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.31	20.30	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.90	0.79	0.61	0.43	0.29	0.19	0.22	0.38	0.67	0.90	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.83	20.04	20.20	20.29	20.31	20.32	20.32	20.32	20.32	20.29	20.09	19.79	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.10	20.29	20.44	20.53	20.54	20.55	20.55	20.55	20.55	20.52	20.34	20.07	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.10	20.29	20.44	20.53	20.54	20.55	20.55	20.55	20.55	20.52	20.34	20.07	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.90	0.79	0.62	0.44	0.30	0.21	0.23	0.39	0.68	0.90	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	710.95	781.38	777.44	671.16	514.16	340.30	225.92	236.58	371.18	564.61	663.39	679.41	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	946.86	918.79	829.60	679.61	514.93	340.33	225.92	236.58	371.42	577.79	776.66	937.45	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	175.51	92.34	38.81	6.09	0.57	0.00	0.00	0.00	0.00	9.81	81.55	191.98	

∑(98)1...5, 10...12 = 596.66 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 7.53 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	596.66		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	125.30	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	501.19	(307b)

Water heating

Annual water heating requirement	1832.43		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	384.81	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1539.24	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.51	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	129.84		(330a)
Total electricity for the above, kWh/year		129.84	(331)
Electricity for lighting (Appendix L)		342.85	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2790.05	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	125.30	x	2.97	x 0.01 =	3.72	(340a)
Space heating from boilers	501.19	x	4.24	x 0.01 =	21.25	(340b)
Water heating from CHP	384.81	x	2.97	x 0.01 =	11.43	(342a)
Water heating from boilers	1539.24	x	4.24	x 0.01 =	65.26	(342b)
Pumps and fans	129.84	x	13.19	x 0.01 =	17.13	(349)
Electricity for lighting	342.85	x	13.19	x 0.01 =	45.22	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		284.01	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	0.96	(357)
SAP value	86.60	
SAP rating (section 13)	87	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	231.8448	x	0.2160	=	50.0785	(363)
less credit emissions for electricity		-76.8702	x	0.5190	=	-39.8956	(364)
Water heated by CHP		712.0298	x	0.2160	=	153.7984	(365)
less credit emissions for electricity		-236.0799	x	0.5190	=	-122.5254	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2094.90	x	0.216	=	452.50	(368)
Electrical energy for community heat distribution		25.51	x	0.519	=	13.24	(372)
Total CO2 associated with community systems						507.19	(373)
Total CO2 associated with space and water heating						507.19	(376)
Pumps and fans		129.84	x	0.519	=	67.39	(378)
Electricity for lighting		342.85	x	0.519	=	177.94	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	631.50	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	7.97	(384)
EI value					93.19	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	231.84	x	1.22	=	282.85	(363)
less credit energy for electricity		-76.87	x	3.07	=	-235.99	(364)
Water heated by CHP		712.03	x	1.22	=	868.68	(365)
less credit energy for electricity		-236.08	x	3.07	=	-724.77	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2094.90	x	1.22	=	2555.78	(368)
Electrical energy for community heat distribution		25.51	x	3.07	=	78.30	(372)
Total primary energy associated with community systems						2824.85	(373)
Total primary energy associated with space and water heating						2824.85	(376)
Pumps and fans		129.84	x	3.07	=	398.60	(378)
Electricity for lighting		342.85	x	3.07	=	1052.54	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3560.15	(383)
Dwelling primary energy rate kWh/m2/year						44.95	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Qr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.20	(1a) x	2.50	(2a) =	198.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	198.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.01	x	1.24	=	24.73			(27)
External wall			49.99	x	0.15	=	7.50			(29a)
Party wall			33.75	x	0.00	=	0.00			(32)
Roof			79.20	x	0.12	=	9.50			(30)
Total area of external elements ∑A, m²			149.20							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.73 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		22.38 (36)
Total fabric heat loss	(33) + (36) =	64.11 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.19	16.98	16.77	15.73	15.52	14.48	14.48	14.27	14.90	15.52	15.94	16.36	(38)

Heat transfer coefficient, W/K (37)m + (38)m

81.30	81.09	80.88	79.84	79.63	78.59	78.59	78.38	79.01	79.63	80.05	80.47	

Average = ∑(39)1...12/12 = 79.79 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.03	1.02	1.02	1.01	1.01	0.99	0.99	0.99	1.00	1.01	1.01	1.02	

Average = ∑(40)1...12/12 = 1.01 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.45 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.33 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.56	97.87	94.17	90.48	86.79	83.10	83.10	86.79	90.48	94.17	97.87	101.56	

∑(44)1...12 = 1107.94 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.61	131.73	135.93	118.51	113.71	98.12	90.93	104.34	105.58	123.05	134.32	145.86	

∑(45)1...12 = 1452.68 (45)

Distribution loss 0.15 x (45)m

22.59	19.76	20.39	17.78	17.06	14.72	13.64	15.65	15.84	18.46	20.15	21.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	

∑(64)1...12 = 1832.43 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.88	67.10	71.00	64.37	63.61	57.60	56.03	60.49	60.08	66.72	69.63	74.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.53	43.11	35.06	26.54	19.84	16.75	18.10	23.52	31.57	40.09	46.79	49.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	325.02	328.39	319.89	301.80	278.96	257.49	243.15	239.78	248.28	266.37	289.21	310.68	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	(71)
Water heating gains (Table 5)	101.99	99.86	95.43	89.41	85.50	79.99	75.32	81.31	83.44	89.67	96.71	99.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	576.62	572.44	551.46	518.83	485.38	455.32	437.65	445.69	464.37	497.22	533.79	561.51	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.24	x	36.79	x 0.9 x	0.50	x	0.90	=	140.44	(79)
NorthWest	0.77	x	7.33	x	11.28	x 0.9 x	0.50	x	0.90	=	25.79	(81)
NorthEast	0.77	x	0.44	x	11.28	x 0.9 x	0.50	x	0.90	=	1.55	(75)

Solar gains in watts ∑(74)m...(82)m

167.78	294.88	427.59	570.23	675.61	686.95	655.54	574.44	476.59	332.41	202.62	142.52	(83)

Total gains - internal and solar (73)m + (83)m

744.40	867.31	979.04	1089.06	1160.98	1142.27	1093.19	1020.14	940.97	829.62	736.41	704.02	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.79	0.62	0.44	0.32	0.35	0.57	0.85	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.24	20.43	20.66	20.88	20.97	21.00	21.00	21.00	20.99	20.85	20.51	20.20

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.06	20.06	20.07	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.07	20.07

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.89	0.75	0.56	0.38	0.25	0.28	0.50	0.81	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.08	19.35	19.67	19.95	20.06	20.09	20.09	20.09	20.08	19.92	19.47	19.03

(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.47	19.71	20.00	20.26	20.36	20.39	20.40	20.40	20.38	20.23	19.82	19.42

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.47	19.71	20.00	20.26	20.36	20.39	20.40	20.40	20.38	20.23	19.82	19.42

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.97	0.95	0.89	0.76	0.58	0.40	0.27	0.31	0.52	0.81	0.95	0.98
(94)												
Useful gains, ηmGm, W (94)m x (84)m	725.42	821.93	870.48	829.15	674.24	453.78	298.13	312.99	489.90	674.93	698.52	689.85
(95)												
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
(96)												
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1233.21	1200.89	1091.87	906.93	689.88	455.28	298.27	313.25	496.35	767.25	1018.34	1224.91
(97)												
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	377.80	254.66	164.71	56.00	11.64	0.00	0.00	0.00	0.00	68.68	230.27	398.08

∑(98)1...5, 10...12 = 1561.84 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.72 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1561.84		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1639.93	(307a)

Water heating

Annual water heating requirement	1832.43		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1924.05	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	35.64	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	129.84		(330a)
Total electricity for the above, kWh/year		129.84	(331)
Electricity for lighting (Appendix L)		342.85	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4036.67	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1639.93	x	4.24	x 0.01 =	69.53	(340a)
Water heating from boilers	1924.05	x	4.24	x 0.01 =	81.58	(342a)
Pumps and fans	129.84	x	13.19	x 0.01 =	17.13	(349)
Electricity for lighting	342.85	x	13.19	x 0.01 =	45.22	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		333.46	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.27	
SAP rating (section 13)	84	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3659.12	x	0.216	=	790.37	(367)
Electrical energy for community heat distribution	35.64	x	0.519	=	18.50	(372)
Total CO2 associated with community systems					808.87	(373)
Total CO2 associated with space and water heating					808.87	(376)
Pumps and fans	129.84	x	0.519	=	67.39	(378)
Electricity for lighting	342.85	x	0.519	=	177.94	(379)
Total CO_2, kg/year				(376)..(382) =	1054.19	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.31	(384)
EI value					88.63	
EI rating (section 14)					89	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3659.12	x	1.22	=	4464.13	(367)
Electrical energy for community heat distribution	35.64	x	3.07	=	109.41	(372)
Total primary energy associated with community systems					4573.54	(373)
Total primary energy associated with space and water heating					4573.54	(376)
Pumps and fans	129.84	x	3.07	=	398.60	(378)
Electricity for lighting	342.85	x	3.07	=	1052.54	(379)

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Primary energy kWh/year	6024.69	(383)
Dwelling primary energy rate kWh/m2/year	76.07	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Qr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.20	(1a) x	2.50	(2a) =	198.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	198.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.01	x	1.24	=	24.73			(27)
External wall			49.99	x	0.15	=	7.50			(29a)
Party wall			33.75	x	0.00	=	0.00			(32)
Roof			79.20	x	0.12	=	9.50			(30)
Total area of external elements ∑A, m²			149.20							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.73 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		22.38 (36)
Total fabric heat loss	(33) + (36) =	64.11 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.19	16.98	16.77	15.73	15.52	14.48	14.48	14.27	14.90	15.52	15.94	16.36	(38)

Heat transfer coefficient, W/K (37)m + (38)m

81.30	81.09	80.88	79.84	79.63	78.59	78.59	78.38	79.01	79.63	80.05	80.47	

Average = ∑(39)1...12/12 = 79.79 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.03	1.02	1.02	1.01	1.01	0.99	0.99	0.99	1.00	1.01	1.01	1.02	

Average = ∑(40)1...12/12 = 1.01 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N: 2.45 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 92.33 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.56	97.87	94.17	90.48	86.79	83.10	83.10	86.79	90.48	94.17	97.87	101.56	

∑(44)1...12 = 1107.94 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.61	131.73	135.93	118.51	113.71	98.12	90.93	104.34	105.58	123.05	134.32	145.86	

∑(45)1...12 = 1452.68 (45)

Distribution loss 0.15 x (45)m

22.59	19.76	20.39	17.78	17.06	14.72	13.64	15.65	15.84	18.46	20.15	21.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel: 1.00 (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.29 (48)

Temperature factor from Table 2b: 1.00 (49)

Energy lost from water storage (kWh/day) (48) x (49): 0.29 (50)

Enter (50) or (54) in (55): 0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	

∑(64)1...12 = 1832.43 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.88	67.10	71.00	64.37	63.61	57.60	56.03	60.49	60.08	66.72	69.63	74.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.53	43.11	35.06	26.54	19.84	16.75	18.10	23.52	31.57	40.09	46.79	49.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	325.02	328.39	319.89	301.80	278.96	257.49	243.15	239.78	248.28	266.37	289.21	310.68	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	(71)
Water heating gains (Table 5)	101.99	99.86	95.43	89.41	85.50	79.99	75.32	81.31	83.44	89.67	96.71	99.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	576.62	572.44	551.46	518.83	485.38	455.32	437.65	445.69	464.37	497.22	533.79	561.51	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.24	x	36.79	x 0.9 x	0.50	x	0.90	=	140.44	(79)
NorthWest	0.77	x	7.33	x	11.28	x 0.9 x	0.50	x	0.90	=	25.79	(81)
NorthEast	0.77	x	0.44	x	11.28	x 0.9 x	0.50	x	0.90	=	1.55	(75)

Solar gains in watts ∑(74)m...(82)m

167.78	294.88	427.59	570.23	675.61	686.95	655.54	574.44	476.59	332.41	202.62	142.52	(83)

Total gains - internal and solar (73)m + (83)m

744.40	867.31	979.04	1089.06	1160.98	1142.27	1093.19	1020.14	940.97	829.62	736.41	704.02	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.79	0.62	0.44	0.32	0.35	0.57	0.85	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.24	20.43	20.66	20.88	20.97	21.00	21.00	21.00	20.99	20.85	20.51	20.20

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.06	20.06	20.07	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.07	20.07

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.89	0.75	0.56	0.38	0.25	0.28	0.50	0.81	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.08	19.35	19.67	19.95	20.06	20.09	20.09	20.09	20.08	19.92	19.47	19.03

(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.47	19.71	20.00	20.26	20.36	20.39	20.40	20.40	20.38	20.23	19.82	19.42

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.47	19.71	20.00	20.26	20.36	20.39	20.40	20.40	20.38	20.23	19.82	19.42

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.89	0.76	0.58	0.40	0.27	0.31	0.52	0.81	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	725.42	821.93	870.48	829.15	674.24	453.78	298.13	312.99	489.90	674.93	698.52	689.85	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1233.21	1200.89	1091.87	906.93	689.88	455.28	298.27	313.25	496.35	767.25	1018.34	1224.91	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	377.80	254.66	164.71	56.00	11.64	0.00	0.00	0.00	0.00	68.68	230.27	398.08	

∑(98)1...5, 10...12 = 1561.84 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.72 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1561.84		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	327.99	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1311.95	(307b)

Water heating

Annual water heating requirement	1832.43		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	384.81	(310a)

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Water heat from boilers	(64) x (303b) x (305a) x (306) =	1539.24	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	35.64	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	129.84	(330a)
Total electricity for the above, kWh/year	129.84	(331)
Electricity for lighting (Appendix L)	342.85	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4036.67	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	327.99	x	2.97	x 0.01 =	9.74	(340a)
Space heating from boilers	1311.95	x	4.24	x 0.01 =	55.63	(340b)
Water heating from CHP	384.81	x	2.97	x 0.01 =	11.43	(342a)
Water heating from boilers	1539.24	x	4.24	x 0.01 =	65.26	(342b)
Pumps and fans	129.84	x	13.19	x 0.01 =	17.13	(349)
Electricity for lighting	342.85	x	13.19	x 0.01 =	45.22	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		324.41	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.70	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	606.8871	x	0.2160	=	131.0876	(363)
less credit emissions for electricity		-201.2188	x	0.5190	=	-104.4326	(364)
Water heated by CHP		712.0298	x	0.2160	=	153.7984	(365)
less credit emissions for electricity		-236.0799	x	0.5190	=	-122.5254	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2927.30	x	0.216	=	632.30	(368)
Electrical energy for community heat distribution		35.64	x	0.519	=	18.50	(372)
Total CO2 associated with community systems						708.72	(373)
Total CO2 associated with space and water heating						708.72	(376)
Pumps and fans		129.84	x	0.519	=	67.39	(378)
Electricity for lighting		342.85	x	0.519	=	177.94	(379)
Total CO_2, kg/year					(376)..(382) =	954.05	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.05	(384)
EI value						89.71	

EI rating (section 14)	90	(385)
EI band	B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	606.89	x	1.22	=	740.40	(363)
less credit energy for electricity		-201.22	x	3.07	=	-617.74	(364)
Water heated by CHP		712.03	x	1.22	=	868.68	(365)
less credit energy for electricity		-236.08	x	3.07	=	-724.77	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2927.30	x	1.22	=	3571.30	(368)
Electrical energy for community heat distribution		35.64	x	3.07	=	109.41	(372)
Total primary energy associated with community systems						3947.29	(373)
Total primary energy associated with space and water heating						3947.29	(376)
Pumps and fans		129.84	x	3.07	=	398.60	(378)
Electricity for lighting		342.85	x	3.07	=	1052.54	(379)
Primary energy kWh/year						5398.44	(383)
Dwelling primary energy rate kWh/m2/year						68.16	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Qr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.20	(1a) x	2.50	(2a) =	198.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	198.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			20.01	x	1.24	=	24.73			(27)
External wall			49.99	x	0.15	=	7.50			(29a)
Party wall			33.75	x	0.00	=	0.00			(32)
Roof			79.20	x	0.12	=	9.50			(30)
Total area of external elements ∑A, m²			149.20							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.73 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		22.38 (36)
Total fabric heat loss	(33) + (36) =	64.11 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
17.19	16.98	16.77	15.73	15.52	14.48	14.48	14.27	14.90	15.52	15.94	16.36	(38)

Heat transfer coefficient, W/K (37)m + (38)m

81.30	81.09	80.88	79.84	79.63	78.59	78.59	78.38	79.01	79.63	80.05	80.47	

Average = ∑(39)1...12/12 = 79.79 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.03	1.02	1.02	1.01	1.01	0.99	0.99	0.99	1.00	1.01	1.01	1.02	

Average = ∑(40)1...12/12 = 1.01 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.45 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.33 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.56	97.87	94.17	90.48	86.79	83.10	83.10	86.79	90.48	94.17	97.87	101.56	

∑(44)1...12 = 1107.94 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.61	131.73	135.93	118.51	113.71	98.12	90.93	104.34	105.58	123.05	134.32	145.86	

∑(45)1...12 = 1452.68 (45)

Distribution loss 0.15 x (45)m

22.59	19.76	20.39	17.78	17.06	14.72	13.64	15.65	15.84	18.46	20.15	21.88	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

182.86	160.86	168.18	149.72	145.96	129.34	123.18	136.59	136.80	155.30	165.53	178.11	

∑(64)1...12 = 1832.43 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.88	67.10	71.00	64.37	63.61	57.60	56.03	60.49	60.08	66.72	69.63	74.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	146.85	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.53	43.11	35.06	26.54	19.84	16.75	18.10	23.52	31.57	40.09	46.79	49.88	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	325.02	328.39	319.89	301.80	278.96	257.49	243.15	239.78	248.28	266.37	289.21	310.68	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	52.13	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	-97.90	(71)
Water heating gains (Table 5)	101.99	99.86	95.43	89.41	85.50	79.99	75.32	81.31	83.44	89.67	96.71	99.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	576.62	572.44	551.46	518.83	485.38	455.32	437.65	445.69	464.37	497.22	533.79	561.51	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.24	x	36.79	x 0.9 x	0.50	x	0.90	=	140.44	(79)
NorthWest	0.77	x	7.33	x	11.28	x 0.9 x	0.50	x	0.90	=	25.79	(81)
NorthEast	0.77	x	0.44	x	11.28	x 0.9 x	0.50	x	0.90	=	1.55	(75)

Solar gains in watts ∑(74)m...(82)m

167.78	294.88	427.59	570.23	675.61	686.95	655.54	574.44	476.59	332.41	202.62	142.52	(83)

Total gains - internal and solar (73)m + (83)m

744.40	867.31	979.04	1089.06	1160.98	1142.27	1093.19	1020.14	940.97	829.62	736.41	704.02	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.79	0.62	0.44	0.32	0.35	0.57	0.85	0.96	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.24	20.43	20.66	20.88	20.97	21.00	21.00	21.00	20.99	20.85	20.51	20.20

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.06	20.06	20.07	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.07	20.07

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.95	0.89	0.75	0.56	0.38	0.25	0.28	0.50	0.81	0.95	0.98

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.08	19.35	19.67	19.95	20.06	20.09	20.09	20.09	20.08	19.92	19.47	19.03

(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.47	19.71	20.00	20.26	20.36	20.39	20.40	20.40	20.38	20.23	19.82	19.42

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.47	19.71	20.00	20.26	20.36	20.39	20.40	20.40	20.38	20.23	19.82	19.42

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.89	0.76	0.58	0.40	0.27	0.31	0.52	0.81	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	725.42	821.93	870.48	829.15	674.24	453.78	298.13	312.99	489.90	674.93	698.52	689.85	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1233.21	1200.89	1091.87	906.93	689.88	455.28	298.27	313.25	496.35	767.25	1018.34	1224.91	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	377.80	254.66	164.71	56.00	11.64	0.00	0.00	0.00	0.00	68.68	230.27	398.08	

∑(98)1...5, 10...12 = 1561.84 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.72 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1561.84		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	327.99	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1311.95	(307b)

Water heating

Annual water heating requirement	1832.43		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	384.81	(310a)

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Water heat from boilers	(64) x (303b) x (305a) x (306) =	1539.24	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	35.64	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	129.84		(330a)
Total electricity for the above, kWh/year		129.84	(331)
Electricity for lighting (Appendix L)		342.85	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3803.49	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	327.99	x	2.97	x 0.01 =	9.74	(340a)
Space heating from boilers	1311.95	x	4.24	x 0.01 =	55.63	(340b)
Water heating from CHP	384.81	x	2.97	x 0.01 =	11.43	(342a)
Water heating from boilers	1539.24	x	4.24	x 0.01 =	65.26	(342b)
Pumps and fans	129.84	x	13.19	x 0.01 =	17.13	(349)
Electricity for lighting	342.85	x	13.19	x 0.01 =	45.22	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		324.41	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.10	(357)
SAP value	84.70	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	606.8871	x	0.2160	=	131.0876	(363)
less credit emissions for electricity		-201.2188	x	0.5190	=	-104.4326	(364)
Water heated by CHP		712.0298	x	0.2160	=	153.7984	(365)
less credit emissions for electricity		-236.0799	x	0.5190	=	-122.5254	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2927.30	x	0.216	=	632.30	(368)
Electrical energy for community heat distribution		35.64	x	0.519	=	18.50	(372)
Total CO2 associated with community systems						708.72	(373)
Total CO2 associated with space and water heating						708.72	(376)
Pumps and fans		129.84	x	0.519	=	67.39	(378)

Electricity for lighting	342.85	x	0.519	=	177.94	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	833.03	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.52	(384)
EI value					91.01	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	606.89	x	1.22	=	740.40	(363)
less credit energy for electricity		-201.22	x	3.07	=	-617.74	(364)
Water heated by CHP		712.03	x	1.22	=	868.68	(365)
less credit energy for electricity		-236.08	x	3.07	=	-724.77	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2927.30	x	1.22	=	3571.30	(368)
Electrical energy for community heat distribution		35.64	x	3.07	=	109.41	(372)
Total primary energy associated with community systems						3947.29	(373)
Total primary energy associated with space and water heating						3947.29	(376)
Pumps and fans		129.84	x	3.07	=	398.60	(378)
Electricity for lighting		342.85	x	3.07	=	1052.54	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						4682.58	(383)
Dwelling primary energy rate kWh/m2/year						59.12	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ro 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		61.20	(1a) x	2.50	(2a) =	153.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	61.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	153.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.84	x	1.24	=	24.52			(27)
External wall			40.16	x	0.15	=	6.02			(29a)
Party wall			46.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			60.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.54 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.00 (36)
Total fabric heat loss	(33) + (36) =	39.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.28	13.12	12.96	12.16	11.99	11.19	11.19	11.03	11.51	11.99	12.32	12.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

52.82	52.66	52.50	51.70	51.54	50.73	50.73	50.57	51.05	51.54	51.86	52.18	

Average = ∑(39)1...12/12 = 51.66 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.86	0.86	0.86	0.84	0.84	0.83	0.83	0.83	0.83	0.84	0.85	0.85	

Average = ∑(40)1...12/12 = 0.84 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.02 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		82.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.27	86.99	83.71	80.42	77.14	73.86	73.86	77.14	80.42	83.71	86.99	90.27	

∑(44)1...12 = 984.78 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.87	117.08	120.82	105.33	101.07	87.22	80.82	92.74	93.85	109.37	119.39	129.65	

∑(45)1...12 = 1291.20 (45)

Distribution loss 0.15 x (45)m

20.08	17.56	18.12	15.80	15.16	13.08	12.12	13.91	14.08	16.41	17.91	19.45	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	

∑(64)1...12 = 1670.94 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.31	62.24	65.97	59.99	59.41	53.97	52.67	56.64	56.17	62.17	64.67	68.91	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.22	34.83	28.33	21.45	16.03	13.53	14.62	19.01	25.51	32.40	37.81	40.31	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.63	265.36	258.49	243.87	225.41	208.07	196.48	193.75	200.62	215.24	233.70	251.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	(71)
Water heating gains (Table 5)	94.51	92.61	88.68	83.32	79.85	74.96	70.80	76.13	78.02	83.56	89.81	92.62	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

485.77	482.22	464.91	438.05	410.71	385.97	371.32	378.30	393.57	420.61	450.74	473.39	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.32	x	46.75	x 0.9 x	0.50	x	0.90	=	150.46	(78)
East	0.77	x	4.42	x	19.64	x 0.9 x	0.50	x	0.90	=	27.07	(76)
North	0.77	x	5.10	x	10.63	x 0.9 x	0.50	x	0.90	=	16.91	(74)

Solar gains in watts ∑(74)m...(82)m

194.45	331.69	456.02	570.18	644.40	642.56	618.30	562.31	495.36	367.10	232.97	166.37	(83)

Total gains - internal and solar (73)m + (83)m

680.22	813.91	920.93	1008.23	1055.11	1028.53	989.62	940.61	888.93	787.71	683.70	639.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.95	0.88	0.77	0.61	0.45	0.32	0.23	0.25	0.40	0.66	0.89	0.96	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.62	20.79	20.92	20.98	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.57	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.20	20.20	20.20	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.94	0.86	0.74	0.57	0.42	0.28	0.19	0.21	0.35	0.62	0.86	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.72	19.95	20.11	20.20	20.21	20.23	20.23	20.23	20.22	20.19	20.00	19.67	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.20	20.40	20.55	20.62	20.64	20.64	20.64	20.65	20.64	20.62	20.44	20.16	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.20	20.40	20.55	20.62	20.64	20.64	20.64	20.65	20.64	20.62	20.44	20.16	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.94	0.87	0.75	0.59	0.44	0.30	0.21	0.23	0.38	0.64	0.87	0.95	(94)
Useful gains, ηmGm, W (94)m x (84)m	637.37	704.70	693.45	596.79	459.38	306.56	205.17	214.68	333.63	504.26	595.52	608.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	840.04	816.39	737.41	605.91	460.57	306.63	205.18	214.69	333.97	516.18	691.74	832.65	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	150.78	75.06	32.70	6.57	0.89	0.00	0.00	0.00	0.00	8.87	69.28	167.09	

∑(98)1...5, 10...12 = 511.23 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.35 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	511.23		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	536.80	(307a)

Water heating

Annual water heating requirement	1670.94		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1754.49	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	22.91	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	100.33	(330a)

Total electricity for the above, kWh/year		100.33	(331)
Electricity for lighting (Appendix L)		277.04	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2668.66	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	536.80	x	4.24	x 0.01 =	22.76	(340a)
Water heating from boilers	1754.49	x	4.24	x 0.01 =	74.39	(342a)
Pumps and fans	100.33	x	13.19	x 0.01 =	13.23	(349)
Electricity for lighting	277.04	x	13.19	x 0.01 =	36.54	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		266.93	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.06	(357)
SAP value	85.27	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2352.45	x	0.216	=	508.13	(367)
Electrical energy for community heat distribution		22.91	x	0.519	=	11.89	(372)
Total CO2 associated with community systems						520.02	(373)
Total CO2 associated with space and water heating						520.02	(376)
Pumps and fans		100.33	x	0.519	=	52.07	(378)
Electricity for lighting		277.04	x	0.519	=	143.78	(379)
Total CO_2, kg/year					(376)..(382) =	715.88	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.70	(384)
EI value						90.97	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2352.45	x	1.22	=	2869.99	(367)
Electrical energy for community heat distribution		22.91	x	3.07	=	70.34	(372)
Total primary energy associated with community systems						2940.33	(373)
Total primary energy associated with space and water heating						2940.33	(376)
Pumps and fans		100.33	x	3.07	=	308.01	(378)
Electricity for lighting		277.04	x	3.07	=	850.52	(379)
Primary energy kWh/year						4098.86	(383)

Dwelling primary energy rate kWh/m2/year	66.97	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	27/07/2018
Address	Ro 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		61.20	(1a) x	2.50	(2a) =	153.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	61.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	153.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.84	x	1.24	=	24.52			(27)
External wall			40.16	x	0.15	=	6.02			(29a)
Party wall			46.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			60.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.54 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.00 (36)
Total fabric heat loss	(33) + (36) =	39.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.28	13.12	12.96	12.16	11.99	11.19	11.19	11.03	11.51	11.99	12.32	12.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

52.82	52.66	52.50	51.70	51.54	50.73	50.73	50.57	51.05	51.54	51.86	52.18	

Average = ∑(39)1...12/12 = 51.66 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.86	0.86	0.86	0.84	0.84	0.83	0.83	0.83	0.83	0.84	0.85	0.85	

Average = ∑(40)1...12/12 = 0.84 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.02 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.27	86.99	83.71	80.42	77.14	73.86	73.86	77.14	80.42	83.71	86.99	90.27	

∑(44)1...12 = 984.78 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.87	117.08	120.82	105.33	101.07	87.22	80.82	92.74	93.85	109.37	119.39	129.65	

∑(45)1...12 = 1291.20 (45)

Distribution loss 0.15 x (45)m

20.08	17.56	18.12	15.80	15.16	13.08	12.12	13.91	14.08	16.41	17.91	19.45	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	

∑(64)1...12 = 1670.94 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.31	62.24	65.97	59.99	59.41	53.97	52.67	56.64	56.17	62.17	64.67	68.91	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.22	34.83	28.33	21.45	16.03	13.53	14.62	19.01	25.51	32.40	37.81	40.31	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.63	265.36	258.49	243.87	225.41	208.07	196.48	193.75	200.62	215.24	233.70	251.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	(71)
Water heating gains (Table 5)	94.51	92.61	88.68	83.32	79.85	74.96	70.80	76.13	78.02	83.56	89.81	92.62	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

485.77	482.22	464.91	438.05	410.71	385.97	371.32	378.30	393.57	420.61	450.74	473.39	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.32	x	46.75	x 0.9 x	0.50	x	0.90	=	150.46	(78)
East	0.77	x	4.42	x	19.64	x 0.9 x	0.50	x	0.90	=	27.07	(76)
North	0.77	x	5.10	x	10.63	x 0.9 x	0.50	x	0.90	=	16.91	(74)

Solar gains in watts ∑(74)m...(82)m

194.45	331.69	456.02	570.18	644.40	642.56	618.30	562.31	495.36	367.10	232.97	166.37	(83)

Total gains - internal and solar (73)m + (83)m

680.22	813.91	920.93	1008.23	1055.11	1028.53	989.62	940.61	888.93	787.71	683.70	639.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.95	0.88	0.77	0.61	0.45	0.32	0.23	0.25	0.40	0.66	0.89	0.96	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.62	20.79	20.92	20.98	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.57	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.20	20.20	20.20	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.94	0.86	0.74	0.57	0.42	0.28	0.19	0.21	0.35	0.62	0.86	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.72	19.95	20.11	20.20	20.21	20.23	20.23	20.23	20.22	20.19	20.00	19.67	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.20	20.40	20.55	20.62	20.64	20.64	20.64	20.65	20.64	20.62	20.44	20.16	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.20	20.40	20.55	20.62	20.64	20.64	20.64	20.65	20.64	20.62	20.44	20.16	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.94	0.87	0.75	0.59	0.44	0.30	0.21	0.23	0.38	0.64	0.87	0.95	(94)
Useful gains, ηmGm, W (94)m x (84)m	637.37	704.70	693.45	596.79	459.38	306.56	205.17	214.68	333.63	504.26	595.52	608.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	840.04	816.39	737.41	605.91	460.57	306.63	205.18	214.69	333.97	516.18	691.74	832.65	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	150.78	75.06	32.70	6.57	0.89	0.00	0.00	0.00	0.00	8.87	69.28	167.09	

∑(98)1...5, 10...12 = 511.23 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.35 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	511.23		(98)
Space heat from CHP		(98) x (304a) x (305) x (306) = 107.36	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) = 429.44	(307b)

Water heating

Annual water heating requirement	1670.94		(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) = 350.90	(310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) = 1403.59	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	22.91	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	100.33		(330a)
Total electricity for the above, kWh/year		100.33	(331)
Electricity for lighting (Appendix L)		277.04	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2668.66	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	107.36	x	2.97	x 0.01 =	3.19	(340a)
Space heating from boilers	429.44	x	4.24	x 0.01 =	18.21	(340b)
Water heating from CHP	350.90	x	2.97	x 0.01 =	10.42	(342a)
Water heating from boilers	1403.59	x	4.24	x 0.01 =	59.51	(342b)
Pumps and fans	100.33	x	13.19	x 0.01 =	13.23	(349)
Electricity for lighting	277.04	x	13.19	x 0.01 =	36.54	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		261.11	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.59	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	198.6508	x	0.2160	=	42.9086	(363)
less credit emissions for electricity		-65.8645	x	0.5190	=	-34.1837	(364)
Water heated by CHP		649.2804	x	0.2160	=	140.2446	(365)
less credit emissions for electricity		-215.2747	x	0.5190	=	-111.7276	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1881.96	x	0.216	=	406.50	(368)
Electrical energy for community heat distribution		22.91	x	0.519	=	11.89	(372)
Total CO2 associated with community systems						455.64	(373)
Total CO2 associated with space and water heating						455.64	(376)
Pumps and fans		100.33	x	0.519	=	52.07	(378)
Electricity for lighting		277.04	x	0.519	=	143.78	(379)
Total CO_2, kg/year					(376)..(382) =	651.49	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.65	(384)
EI value						91.78	
EI rating (section 14)						92	(385)

EI band | A

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	198.65	x	1.22	=	242.35	(363)
less credit energy for electricity		-65.86	x	3.07	=	-202.20	(364)
Water heated by CHP		649.28	x	1.22	=	792.12	(365)
less credit energy for electricity		-215.27	x	3.07	=	-660.89	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1881.96	x	1.22	=	2295.99	(368)
Electrical energy for community heat distribution		22.91	x	3.07	=	70.34	(372)
Total primary energy associated with community systems						2537.71	(373)
Total primary energy associated with space and water heating						2537.71	(376)
Pumps and fans		100.33	x	3.07	=	308.01	(378)
Electricity for lighting		277.04	x	3.07	=	850.52	(379)
Primary energy kWh/year						3696.24	(383)
Dwelling primary energy rate kWh/m2/year						60.40	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ro 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		61.20	(1a) x	2.50	(2a) =	153.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	61.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	153.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.84	x	1.24	=	24.52			(27)
External wall			40.16	x	0.15	=	6.02			(29a)
Party wall			46.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			60.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	30.54 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.00 (36)
Total fabric heat loss	(33) + (36) =	39.54 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.28	13.12	12.96	12.16	11.99	11.19	11.19	11.03	11.51	11.99	12.32	12.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

52.82	52.66	52.50	51.70	51.54	50.73	50.73	50.57	51.05	51.54	51.86	52.18	

Average = ∑(39)1...12/12 = 51.66 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.86	0.86	0.86	0.84	0.84	0.83	0.83	0.83	0.83	0.84	0.85	0.85	

Average = ∑(40)1...12/12 = 0.84 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.02 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.27	86.99	83.71	80.42	77.14	73.86	73.86	77.14	80.42	83.71	86.99	90.27	

∑(44)1...12 = 984.78 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.87	117.08	120.82	105.33	101.07	87.22	80.82	92.74	93.85	109.37	119.39	129.65	

∑(45)1...12 = 1291.20 (45)

Distribution loss 0.15 x (45)m

20.08	17.56	18.12	15.80	15.16	13.08	12.12	13.91	14.08	16.41	17.91	19.45	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	

∑(64)1...12 = 1670.94 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.31	62.24	65.97	59.99	59.41	53.97	52.67	56.64	56.17	62.17	64.67	68.91	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.22	34.83	28.33	21.45	16.03	13.53	14.62	19.01	25.51	32.40	37.81	40.31	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.63	265.36	258.49	243.87	225.41	208.07	196.48	193.75	200.62	215.24	233.70	251.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	(71)
Water heating gains (Table 5)	94.51	92.61	88.68	83.32	79.85	74.96	70.80	76.13	78.02	83.56	89.81	92.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	485.77	482.22	464.91	438.05	410.71	385.97	371.32	378.30	393.57	420.61	450.74	473.39	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.32	x	46.75	x 0.9 x	0.50	x	0.90	=	150.46	(78)
East	0.77	x	4.42	x	19.64	x 0.9 x	0.50	x	0.90	=	27.07	(76)
North	0.77	x	5.10	x	10.63	x 0.9 x	0.50	x	0.90	=	16.91	(74)

Solar gains in watts ∑(74)m...(82)m

194.45	331.69	456.02	570.18	644.40	642.56	618.30	562.31	495.36	367.10	232.97	166.37	(83)

Total gains - internal and solar (73)m + (83)m

680.22	813.91	920.93	1008.23	1055.11	1028.53	989.62	940.61	888.93	787.71	683.70	639.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.95	0.88	0.77	0.61	0.45	0.32	0.23	0.25	0.40	0.66	0.89	0.96	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.62	20.79	20.92	20.98	21.00	21.00	21.00	21.00	21.00	20.98	20.82	20.57	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.20	20.20	20.20	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.94	0.86	0.74	0.57	0.42	0.28	0.19	0.21	0.35	0.62	0.86	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.72	19.95	20.11	20.20	20.21	20.23	20.23	20.23	20.22	20.19	20.00	19.67	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.20	20.40	20.55	20.62	20.64	20.64	20.64	20.65	20.64	20.62	20.44	20.16	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.20	20.40	20.55	20.62	20.64	20.64	20.64	20.65	20.64	20.62	20.44	20.16	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.94	0.87	0.75	0.59	0.44	0.30	0.21	0.23	0.38	0.64	0.87	0.95	(94)
Useful gains, ηmGm, W (94)m x (84)m	637.37	704.70	693.45	596.79	459.38	306.56	205.17	214.68	333.63	504.26	595.52	608.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	840.04	816.39	737.41	605.91	460.57	306.63	205.18	214.69	333.97	516.18	691.74	832.65	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	150.78	75.06	32.70	6.57	0.89	0.00	0.00	0.00	0.00	8.87	69.28	167.09	

∑(98)1...5, 10...12 = 511.23 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.35 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	511.23		(98)
Space heat from CHP		(98) x (304a) x (305) x (306) = 107.36	(307a)
Space heat from boilers		(98) x (304b) x (305) x (306) = 429.44	(307b)

Water heating

Annual water heating requirement	1670.94		(64)
Water heat from CHP		(64) x (303a) x (305a) x (306) = 350.90	(310a)
Water heat from boilers		(64) x (303b) x (305a) x (306) = 1403.59	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	22.91	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	100.33		(330a)
Total electricity for the above, kWh/year		100.33	(331)
Electricity for lighting (Appendix L)		277.04	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2435.48	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	107.36	x	2.97	x 0.01 =	3.19	(340a)
Space heating from boilers	429.44	x	4.24	x 0.01 =	18.21	(340b)
Water heating from CHP	350.90	x	2.97	x 0.01 =	10.42	(342a)
Water heating from boilers	1403.59	x	4.24	x 0.01 =	59.51	(342b)
Pumps and fans	100.33	x	13.19	x 0.01 =	13.23	(349)
Electricity for lighting	277.04	x	13.19	x 0.01 =	36.54	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		261.11	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.59	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	198.6508	x	0.2160	=	42.9086	(363)
less credit emissions for electricity		-65.8645	x	0.5190	=	-34.1837	(364)
Water heated by CHP		649.2804	x	0.2160	=	140.2446	(365)
less credit emissions for electricity		-215.2747	x	0.5190	=	-111.7276	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1881.96	x	0.216	=	406.50	(368)
Electrical energy for community heat distribution		22.91	x	0.519	=	11.89	(372)
Total CO2 associated with community systems						455.64	(373)
Total CO2 associated with space and water heating						455.64	(376)
Pumps and fans		100.33	x	0.519	=	52.07	(378)
Electricity for lighting		277.04	x	0.519	=	143.78	(379)

Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	530.47	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	8.67	(384)
EI value					93.31	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	198.65	x	1.22	=	242.35	(363)
less credit energy for electricity		-65.86	x	3.07	=	-202.20	(364)
Water heated by CHP		649.28	x	1.22	=	792.12	(365)
less credit energy for electricity		-215.27	x	3.07	=	-660.89	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1881.96	x	1.22	=	2295.99	(368)
Electrical energy for community heat distribution		22.91	x	3.07	=	70.34	(372)
Total primary energy associated with community systems						2537.71	(373)
Total primary energy associated with space and water heating						2537.71	(376)
Pumps and fans		100.33	x	3.07	=	308.01	(378)
Electricity for lighting		277.04	x	3.07	=	850.52	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						2980.39	(383)
Dwelling primary energy rate kWh/m2/year						48.70	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Rr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		61.20	(1a) x	2.50	(2a) =	153.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	61.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	153.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.84	x	1.24	=	24.52			(27)
External wall			40.16	x	0.15	=	6.02			(29a)
Party wall			46.25	x	0.00	=	0.00			(32)
Roof			6.00	x	0.12	=	0.72			(30)
Total area of external elements ∑A, m²			66.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.26 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.90 (36)
Total fabric heat loss	(33) + (36) =	41.16 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.28	13.12	12.96	12.16	11.99	11.19	11.19	11.03	11.51	11.99	12.32	12.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

54.44	54.28	54.12	53.32	53.16	52.35	52.35	52.19	52.67	53.16	53.48	53.80	

Average = ∑(39)1...12/12 = 53.28 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.87	0.88	

Average = ∑(40)1...12/12 = 0.87 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.02 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		82.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.27	86.99	83.71	80.42	77.14	73.86	73.86	77.14	80.42	83.71	86.99	90.27	

∑(44)1...12 = 984.78 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.87	117.08	120.82	105.33	101.07	87.22	80.82	92.74	93.85	109.37	119.39	129.65	

∑(45)1...12 = 1291.20 (45)

Distribution loss 0.15 x (45)m

20.08	17.56	18.12	15.80	15.16	13.08	12.12	13.91	14.08	16.41	17.91	19.45	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	

∑(64)1...12 = 1670.94 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.31	62.24	65.97	59.99	59.41	53.97	52.67	56.64	56.17	62.17	64.67	68.91	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.22	34.83	28.33	21.45	16.03	13.53	14.62	19.01	25.51	32.40	37.81	40.31	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.63	265.36	258.49	243.87	225.41	208.07	196.48	193.75	200.62	215.24	233.70	251.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	(71)
Water heating gains (Table 5)	94.51	92.61	88.68	83.32	79.85	74.96	70.80	76.13	78.02	83.56	89.81	92.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	485.77	482.22	464.91	438.05	410.71	385.97	371.32	378.30	393.57	420.61	450.74	473.39	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.32	x	46.75	x 0.9 x	0.50	x	0.90	=	150.46	(78)
East	0.77	x	4.42	x	19.64	x 0.9 x	0.50	x	0.90	=	27.07	(76)
North	0.77	x	5.10	x	10.63	x 0.9 x	0.50	x	0.90	=	16.91	(74)

Solar gains in watts ∑(74)m...(82)m

194.45	331.69	456.02	570.18	644.40	642.56	618.30	562.31	495.36	367.10	232.97	166.37	(83)

Total gains - internal and solar (73)m + (83)m

680.22	813.91	920.93	1008.23	1055.11	1028.53	989.62	940.61	888.93	787.71	683.70	639.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.95	0.89	0.78	0.63	0.47	0.33	0.23	0.26	0.41	0.68	0.90	0.96	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.58	20.76	20.90	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.54

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.18	20.18	20.18	20.19	20.19	20.21	20.21	20.21	20.20	20.19	20.19	20.19

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.94	0.87	0.75	0.59	0.43	0.29	0.19	0.21	0.36	0.63	0.87	0.95

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.65	19.89	20.07	20.17	20.19	20.21	20.21	20.21	20.20	20.17	19.95	19.60

(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.15	20.36	20.52	20.60	20.63	20.63	20.63	20.63	20.63	20.60	20.40	20.10

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.15	20.36	20.52	20.60	20.63	20.63	20.63	20.63	20.63	20.60	20.40	20.10

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.94	0.87	0.77	0.61	0.45	0.31	0.21	0.23	0.39	0.66	0.88	0.95	(94)
Useful gains, ηmGm, W (94)m x (84)m	640.07	711.60	705.70	612.20	472.78	315.76	211.17	221.01	343.51	516.34	601.27	610.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	862.92	839.16	758.63	624.06	474.44	315.87	211.18	221.02	344.00	531.51	711.27	855.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	165.80	85.72	39.38	8.54	1.24	0.00	0.00	0.00	0.00	11.29	79.20	182.66	

∑(98)1...5, 10...12 = 573.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 9.38 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	573.83		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	602.52	(307a)

Water heating

Annual water heating requirement	1670.94		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1754.49	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.57	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	100.33		(330a)
Total electricity for the above, kWh/year		100.33	(331)
Electricity for lighting (Appendix L)		277.04	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2734.38	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	602.52	x	4.24	x 0.01 =	25.55	(340a)
Water heating from boilers	1754.49	x	4.24	x 0.01 =	74.39	(342a)
Pumps and fans	100.33	x	13.19	x 0.01 =	13.23	(349)
Electricity for lighting	277.04	x	13.19	x 0.01 =	36.54	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		269.71	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.07	(357)
SAP value	85.12	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2419.93	x	0.216	=	522.71	(367)
Electrical energy for community heat distribution	23.57	x	0.519	=	12.23	(372)
Total CO2 associated with community systems					534.94	(373)
Total CO2 associated with space and water heating					534.94	(376)
Pumps and fans	100.33	x	0.519	=	52.07	(378)
Electricity for lighting	277.04	x	0.519	=	143.78	(379)
Total CO_2, kg/year				(376)..(382) =	730.79	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.94	(384)
EI value					90.78	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2419.93	x	1.22	=	2952.32	(367)
Electrical energy for community heat distribution	23.57	x	3.07	=	72.36	(372)
Total primary energy associated with community systems					3024.68	(373)
Total primary energy associated with space and water heating					3024.68	(376)
Pumps and fans	100.33	x	3.07	=	308.01	(378)
Electricity for lighting	277.04	x	3.07	=	850.52	(379)

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Primary energy kWh/year	4183.21	(383)
Dwelling primary energy rate kWh/m2/year	68.35	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Rr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		61.20	(1a) x	2.50	(2a) =	153.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	61.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	153.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.84	x	1.24	=	24.52			(27)
External wall			40.16	x	0.15	=	6.02			(29a)
Party wall			46.25	x	0.00	=	0.00			(32)
Roof			6.00	x	0.12	=	0.72			(30)
Total area of external elements ∑A, m²			66.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.26 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.90 (36)
Total fabric heat loss	(33) + (36) =	41.16 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.28	13.12	12.96	12.16	11.99	11.19	11.19	11.03	11.51	11.99	12.32	12.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

54.44	54.28	54.12	53.32	53.16	52.35	52.35	52.19	52.67	53.16	53.48	53.80	

Average = ∑(39)1...12/12 = 53.28 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.87	0.88	

Average = ∑(40)1...12/12 = 0.87 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.02	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.06	(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.27	86.99	83.71	80.42	77.14	73.86	73.86	77.14	80.42	83.71	86.99	90.27	

∑(44)1...12 = 984.78 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.87	117.08	120.82	105.33	101.07	87.22	80.82	92.74	93.85	109.37	119.39	129.65	

∑(45)1...12 = 1291.20 (45)

Distribution loss 0.15 x (45)m

20.08	17.56	18.12	15.80	15.16	13.08	12.12	13.91	14.08	16.41	17.91	19.45	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	

∑(64)1...12 = 1670.94 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.31	62.24	65.97	59.99	59.41	53.97	52.67	56.64	56.17	62.17	64.67	68.91	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.22	34.83	28.33	21.45	16.03	13.53	14.62	19.01	25.51	32.40	37.81	40.31	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.63	265.36	258.49	243.87	225.41	208.07	196.48	193.75	200.62	215.24	233.70	251.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	(71)
Water heating gains (Table 5)	94.51	92.61	88.68	83.32	79.85	74.96	70.80	76.13	78.02	83.56	89.81	92.62	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

485.77	482.22	464.91	438.05	410.71	385.97	371.32	378.30	393.57	420.61	450.74	473.39	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.32	x	46.75	x 0.9 x	0.50	x	0.90	=	150.46	(78)
East	0.77	x	4.42	x	19.64	x 0.9 x	0.50	x	0.90	=	27.07	(76)
North	0.77	x	5.10	x	10.63	x 0.9 x	0.50	x	0.90	=	16.91	(74)

Solar gains in watts ∑(74)m...(82)m

194.45	331.69	456.02	570.18	644.40	642.56	618.30	562.31	495.36	367.10	232.97	166.37	(83)

Total gains - internal and solar (73)m + (83)m

680.22	813.91	920.93	1008.23	1055.11	1028.53	989.62	940.61	888.93	787.71	683.70	639.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.95	0.89	0.78	0.63	0.47	0.33	0.23	0.26	0.41	0.68	0.90	0.96	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.58	20.76	20.90	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.54

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.18	20.18	20.18	20.19	20.19	20.21	20.21	20.21	20.20	20.19	20.19	20.19

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.94	0.87	0.75	0.59	0.43	0.29	0.19	0.21	0.36	0.63	0.87	0.95

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.65	19.89	20.07	20.17	20.19	20.21	20.21	20.21	20.20	20.17	19.95	19.60

(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.15	20.36	20.52	20.60	20.63	20.63	20.63	20.63	20.63	20.60	20.40	20.10

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.15	20.36	20.52	20.60	20.63	20.63	20.63	20.63	20.63	20.60	20.40	20.10

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.94	0.87	0.77	0.61	0.45	0.31	0.21	0.23	0.39	0.66	0.88	0.95	(94)
Useful gains, ηmGm, W (94)m x (84)m	640.07	711.60	705.70	612.20	472.78	315.76	211.17	221.01	343.51	516.34	601.27	610.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	862.92	839.16	758.63	624.06	474.44	315.87	211.18	221.02	344.00	531.51	711.27	855.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	165.80	85.72	39.38	8.54	1.24	0.00	0.00	0.00	0.00	11.29	79.20	182.66	

∑(98)1...5, 10...12 = 573.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 9.38 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	573.83		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	120.50	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	482.02	(307b)

Water heating

Annual water heating requirement	1670.94		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	350.90	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1403.59	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.57	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	100.33	(330a)
Total electricity for the above, kWh/year	100.33	(331)
Electricity for lighting (Appendix L)	277.04	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2734.38	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	120.50	x	2.97	x 0.01 =	3.58	(340a)
Space heating from boilers	482.02	x	4.24	x 0.01 =	20.44	(340b)
Water heating from CHP	350.90	x	2.97	x 0.01 =	10.42	(342a)
Water heating from boilers	1403.59	x	4.24	x 0.01 =	59.51	(342b)
Pumps and fans	100.33	x	13.19	x 0.01 =	13.23	(349)
Electricity for lighting	277.04	x	13.19	x 0.01 =	36.54	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		263.73	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.45	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	222.9750	x	0.2160	=	48.1626	(363)
less credit emissions for electricity		-73.9293	x	0.5190	=	-38.3693	(364)
Water heated by CHP		649.2804	x	0.2160	=	140.2446	(365)
less credit emissions for electricity		-215.2747	x	0.5190	=	-111.7276	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1935.95	x	0.216	=	418.16	(368)
Electrical energy for community heat distribution		23.57	x	0.519	=	12.23	(372)
Total CO2 associated with community systems						468.71	(373)
Total CO2 associated with space and water heating						468.71	(376)
Pumps and fans		100.33	x	0.519	=	52.07	(378)
Electricity for lighting		277.04	x	0.519	=	143.78	(379)
Total CO_2, kg/year					(376)..(382) =	664.56	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.86	(384)
EI value						91.61	

EI rating (section 14)	92	(385)
EI band	A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	222.97	x	1.22	=	272.03	(363)
less credit energy for electricity		-73.93	x	3.07	=	-226.96	(364)
Water heated by CHP		649.28	x	1.22	=	792.12	(365)
less credit energy for electricity		-215.27	x	3.07	=	-660.89	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1935.95	x	1.22	=	2361.85	(368)
Electrical energy for community heat distribution		23.57	x	3.07	=	72.36	(372)
Total primary energy associated with community systems						2610.51	(373)
Total primary energy associated with space and water heating						2610.51	(376)
Pumps and fans		100.33	x	3.07	=	308.01	(378)
Electricity for lighting		277.04	x	3.07	=	850.52	(379)
Primary energy kWh/year						3769.04	(383)
Dwelling primary energy rate kWh/m2/year						61.59	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Rr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		61.20	(1a) x	2.50	(2a) =	153.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	61.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	153.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			19.84	x	1.24	=	24.52			(27)
External wall			40.16	x	0.15	=	6.02			(29a)
Party wall			46.25	x	0.00	=	0.00			(32)
Roof			6.00	x	0.12	=	0.72			(30)
Total area of external elements ∑A, m²			66.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.26 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.90 (36)
Total fabric heat loss	(33) + (36) =	41.16 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
13.28	13.12	12.96	12.16	11.99	11.19	11.19	11.03	11.51	11.99	12.32	12.64	(38)

Heat transfer coefficient, W/K (37)m + (38)m

54.44	54.28	54.12	53.32	53.16	52.35	52.35	52.19	52.67	53.16	53.48	53.80	

Average = ∑(39)1...12/12 = 53.28 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.89	0.89	0.88	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.87	0.88	

Average = ∑(40)1...12/12 = 0.87 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.02	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.06	(43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.27	86.99	83.71	80.42	77.14	73.86	73.86	77.14	80.42	83.71	86.99	90.27	

∑(44)1...12 = 984.78 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.87	117.08	120.82	105.33	101.07	87.22	80.82	92.74	93.85	109.37	119.39	129.65	

∑(45)1...12 = 1291.20 (45)

Distribution loss 0.15 x (45)m

20.08	17.56	18.12	15.80	15.16	13.08	12.12	13.91	14.08	16.41	17.91	19.45	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

166.12	146.21	153.07	136.55	133.32	118.43	113.07	124.99	125.06	141.62	150.60	161.90	

∑(64)1...12 = 1670.94 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

70.31	62.24	65.97	59.99	59.41	53.97	52.67	56.64	56.17	62.17	64.67	68.91	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	120.92	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.22	34.83	28.33	21.45	16.03	13.53	14.62	19.01	25.51	32.40	37.81	40.31	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.63	265.36	258.49	243.87	225.41	208.07	196.48	193.75	200.62	215.24	233.70	251.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	49.11	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	-80.61	(71)
Water heating gains (Table 5)	94.51	92.61	88.68	83.32	79.85	74.96	70.80	76.13	78.02	83.56	89.81	92.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	485.77	482.22	464.91	438.05	410.71	385.97	371.32	378.30	393.57	420.61	450.74	473.39	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
South	0.77	x	10.32	x	46.75	x 0.9 x	0.50	x	0.90	=	150.46	(78)
East	0.77	x	4.42	x	19.64	x 0.9 x	0.50	x	0.90	=	27.07	(76)
North	0.77	x	5.10	x	10.63	x 0.9 x	0.50	x	0.90	=	16.91	(74)

Solar gains in watts ∑(74)m...(82)m

194.45	331.69	456.02	570.18	644.40	642.56	618.30	562.31	495.36	367.10	232.97	166.37	(83)

Total gains - internal and solar (73)m + (83)m

680.22	813.91	920.93	1008.23	1055.11	1028.53	989.62	940.61	888.93	787.71	683.70	639.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.95	0.89	0.78	0.63	0.47	0.33	0.23	0.26	0.41	0.68	0.90	0.96	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.58	20.76	20.90	20.98	21.00	21.00	21.00	21.00	21.00	20.97	20.79	20.54

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.18	20.18	20.18	20.19	20.19	20.21	20.21	20.21	20.20	20.19	20.19	20.19

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.94	0.87	0.75	0.59	0.43	0.29	0.19	0.21	0.36	0.63	0.87	0.95

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.65	19.89	20.07	20.17	20.19	20.21	20.21	20.21	20.20	20.17	19.95	19.60

(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.15	20.36	20.52	20.60	20.63	20.63	20.63	20.63	20.63	20.60	20.40	20.10

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.15	20.36	20.52	20.60	20.63	20.63	20.63	20.63	20.63	20.60	20.40	20.10

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, ηm	0.94	0.87	0.77	0.61	0.45	0.31	0.21	0.23	0.39	0.66	0.88	0.95	(94)
Useful gains, ηmGm, W (94)m x (84)m	640.07	711.60	705.70	612.20	472.78	315.76	211.17	221.01	343.51	516.34	601.27	610.06	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	862.92	839.16	758.63	624.06	474.44	315.87	211.18	221.02	344.00	531.51	711.27	855.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	165.80	85.72	39.38	8.54	1.24	0.00	0.00	0.00	0.00	11.29	79.20	182.66	

∑(98)1...5, 10...12 = 573.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 9.38 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	573.83		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	120.50	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	482.02	(307b)

Water heating

Annual water heating requirement	1670.94		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	350.90	(310a)

Water heat from boilers	(64) x (303b) x (305a) x (306) =	1403.59	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	23.57	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	100.33		(330a)
Total electricity for the above, kWh/year		100.33	(331)
Electricity for lighting (Appendix L)		277.04	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2501.21	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	120.50	x	2.97	x 0.01 =	3.58	(340a)
Space heating from boilers	482.02	x	4.24	x 0.01 =	20.44	(340b)
Water heating from CHP	350.90	x	2.97	x 0.01 =	10.42	(342a)
Water heating from boilers	1403.59	x	4.24	x 0.01 =	59.51	(342b)
Pumps and fans	100.33	x	13.19	x 0.01 =	13.23	(349)
Electricity for lighting	277.04	x	13.19	x 0.01 =	36.54	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		263.73	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.04	(357)
SAP value	85.45	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	222.9750	x	0.2160	=	48.1626	(363)
less credit emissions for electricity		-73.9293	x	0.5190	=	-38.3693	(364)
Water heated by CHP		649.2804	x	0.2160	=	140.2446	(365)
less credit emissions for electricity		-215.2747	x	0.5190	=	-111.7276	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1935.95	x	0.216	=	418.16	(368)
Electrical energy for community heat distribution		23.57	x	0.519	=	12.23	(372)
Total CO2 associated with community systems						468.71	(373)
Total CO2 associated with space and water heating						468.71	(376)
Pumps and fans		100.33	x	0.519	=	52.07	(378)

Electricity for lighting	277.04	x	0.519	=	143.78	(379)
Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	543.54	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	8.88	(384)
EI value					93.14	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	222.97	x	1.22	=	272.03	(363)
less credit energy for electricity		-73.93	x	3.07	=	-226.96	(364)
Water heated by CHP		649.28	x	1.22	=	792.12	(365)
less credit energy for electricity		-215.27	x	3.07	=	-660.89	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	1935.95	x	1.22	=	2361.85	(368)
Electrical energy for community heat distribution		23.57	x	3.07	=	72.36	(372)
Total primary energy associated with community systems						2610.51	(373)
Total primary energy associated with space and water heating						2610.51	(376)
Pumps and fans		100.33	x	3.07	=	308.01	(378)
Electricity for lighting		277.04	x	3.07	=	850.52	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3053.18	(383)
Dwelling primary energy rate kWh/m2/year						49.89	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Sr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.70	(1a) x	2.50	(2a) =	191.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	191.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.16	x	1.24	=	17.50			(27)
External wall			19.09	x	0.15	=	2.86			(29a)
Party wall			62.25	x	0.00	=	0.00			(32)
Roof			76.70	x	0.12	=	9.20			(30)
Total area of external elements ∑A, m²			109.95							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.57 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.49 (36)
Total fabric heat loss	(33) + (36) =	46.06 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
16.65	16.44	16.24	15.23	15.03	14.02	14.02	13.82	14.43	15.03	15.44	15.84	(38)

Heat transfer coefficient, W/K (37)m + (38)m

62.70	62.50	62.30	61.29	61.09	60.08	60.08	59.88	60.49	61.09	61.49	61.90	

Average = ∑(39)1...12/12 = 61.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.82	0.81	0.81	0.80	0.80	0.78	0.78	0.78	0.79	0.80	0.80	0.81	

Average = ∑(40)1...12/12 = 0.80 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.40 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
100.25	96.60	92.96	89.31	85.67	82.02	82.02	85.67	89.31	92.96	96.60	100.25	

∑(44)1...12 = 1093.62 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

148.67	130.02	134.17	116.98	112.24	96.86	89.75	102.99	104.22	121.46	132.58	143.97	

∑(45)1...12 = 1433.91 (45)

Distribution loss 0.15 x (45)m

22.30	19.50	20.13	17.55	16.84	14.53	13.46	15.45	15.63	18.22	19.89	21.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

180.92	159.16	166.43	148.19	144.49	128.07	122.00	135.24	135.43	153.71	163.79	176.23	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

180.92	159.16	166.43	148.19	144.49	128.07	122.00	135.24	135.43	153.71	163.79	176.23	

∑(64)1...12 = 1813.66 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.23	66.54	70.41	63.86	63.12	57.17	55.64	60.05	59.62	66.19	69.05	73.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	47.34	42.05	34.20	25.89	19.35	16.34	17.65	22.95	30.80	39.11	45.64	48.66	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.02	320.31	312.02	294.37	272.10	251.16	237.17	233.88	242.17	259.82	282.10	303.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	(71)
Water heating gains (Table 5)	101.12	99.01	94.64	88.70	84.84	79.41	74.79	80.71	82.81	88.96	95.91	99.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	565.21	561.10	540.59	508.69	476.02	446.63	429.34	437.26	455.51	487.61	523.37	550.44	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	14.16	x	19.64	x 0.9 x	0.50	x	0.90	=	86.73	(76)

Solar gains in watts ∑(74)m...(82)m

86.73	169.66	279.40	407.49	499.39	511.22	486.70	418.07	324.96	201.31	108.14	71.32	(83)

Total gains - internal and solar (73)m + (83)m

651.94	730.76	819.99	916.18	975.41	957.85	916.04	855.33	780.46	688.92	631.51	621.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.76	0.58	0.40	0.29	0.32	0.53	0.83	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.47	20.61	20.79	20.95	20.99	21.00	21.00	21.00	21.00	20.92	20.68	20.44	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.24	20.24	20.24	20.25	20.26	20.27	20.27	20.27	20.26	20.26	20.25	20.25	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.96	0.89	0.73	0.53	0.36	0.24	0.27	0.48	0.80	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.55	19.74	20.00	20.20	20.25	20.27	20.27	20.27	20.26	20.18	19.85	19.52	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.93	20.10	20.32	20.50	20.55	20.57	20.57	20.57	20.56	20.48	20.19	19.90	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.93	20.10	20.32	20.50	20.55	20.57	20.57	20.57	20.56	20.48	20.19	19.90	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.89	0.74	0.55	0.37	0.26	0.29	0.50	0.81	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	636.82	697.01	730.14	678.12	536.44	358.22	238.31	249.55	389.12	556.43	600.53	610.33	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	979.77	949.78	861.17	711.19	540.82	358.47	238.33	249.59	390.81	603.57	804.98	971.50	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	255.16	169.86	97.49	23.81	3.26	0.00	0.00	0.00	0.00	35.08	147.21	268.71	

∑(98)1...5, 10...12 = 1000.57 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.05 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11) — '0' if none = 0.00 (301)

Fraction of space heat from community system — 1 - (301) = 1.00 (302)

Fraction of community heat from boilers — 1.00 (303a)

Fraction of total space heat from community boilers — (302) x (303a) = 1.00 (304a)

Factor for control and charging method (Table 4c(3)) for community space heating — 1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating — 1.00 (305a)

Distribution loss factor (Table 12c) for community heating system — 1.05 (306)

Space heating

Annual space heating requirement — 1000.57 (98)

Space heat from boilers — (98) x (304a) x (305) x (306) = 1050.60 (307a)

Water heating

Annual water heating requirement — 1813.66 (64)

Water heat from boilers — (64) x (303a) x (305a) x (306) = 1904.34 (310a)

Electricity used for heat distribution — 0.01 × [(307a)...(307e) + (310a)...(310e)] = 29.55 (313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside — 116.97 (330a)

Total electricity for the above, kWh/year — 116.97 (331)

Electricity for lighting (Appendix L)		334.42	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3406.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1050.60	x	4.24	x 0.01 =	44.55	(340a)
Water heating from boilers	1904.34	x	4.24	x 0.01 =	80.74	(342a)
Pumps and fans	116.97	x	13.19	x 0.01 =	15.43	(349)
Electricity for lighting	334.42	x	13.19	x 0.01 =	44.11	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		304.83	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.32	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3033.81	x	0.216	=	655.30	(367)
Electrical energy for community heat distribution	29.55	x	0.519	=	15.34	(372)
Total CO2 associated with community systems					670.64	(373)
Total CO2 associated with space and water heating					670.64	(376)
Pumps and fans	116.97	x	0.519	=	60.71	(378)
Electricity for lighting	334.42	x	0.519	=	173.56	(379)
Total CO_2, kg/year				(376)..(382) =	904.91	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.80	(384)
EI value					90.04	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3033.81	x	1.22	=	3701.25	(367)
Electrical energy for community heat distribution	29.55	x	3.07	=	90.72	(372)
Total primary energy associated with community systems					3791.97	(373)
Total primary energy associated with space and water heating					3791.97	(376)
Pumps and fans	116.97	x	3.07	=	359.09	(378)
Electricity for lighting	334.42	x	3.07	=	1026.66	(379)
Primary energy kWh/year					5177.72	(383)
Dwelling primary energy rate kWh/m2/year					67.51	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Sr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.70	(1a) x	2.50	(2a) =	191.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	191.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.16	x	1.24	=	17.50			(27)
External wall			19.09	x	0.15	=	2.86			(29a)
Party wall			62.25	x	0.00	=	0.00			(32)
Roof			76.70	x	0.12	=	9.20			(30)
Total area of external elements ∑A, m²			109.95							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.57 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.49 (36)
Total fabric heat loss	(33) + (36) =	46.06 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
16.65	16.44	16.24	15.23	15.03	14.02	14.02	13.82	14.43	15.03	15.44	15.84	(38)

Heat transfer coefficient, W/K (37)m + (38)m

62.70	62.50	62.30	61.29	61.09	60.08	60.08	59.88	60.49	61.09	61.49	61.90	

Average = ∑(39)1...12/12 = 61.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.82	0.81	0.81	0.80	0.80	0.78	0.78	0.78	0.79	0.80	0.80	0.81	

Average = ∑(40)1...12/12 = 0.80 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.40 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	91.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
100.25	96.60	92.96	89.31	85.67	82.02	82.02	85.67	89.31	92.96	96.60	100.25	

∑(44)1...12 = 1093.62 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

148.67	130.02	134.17	116.98	112.24	96.86	89.75	102.99	104.22	121.46	132.58	143.97	

∑(45)1...12 = 1433.91 (45)

Distribution loss 0.15 x (45)m

22.30	19.50	20.13	17.55	16.84	14.53	13.46	15.45	15.63	18.22	19.89	21.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

180.92	159.16	166.43	148.19	144.49	128.07	122.00	135.24	135.43	153.71	163.79	176.23	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

180.92	159.16	166.43	148.19	144.49	128.07	122.00	135.24	135.43	153.71	163.79	176.23	

∑(64)1...12 = 1813.66 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.23	66.54	70.41	63.86	63.12	57.17	55.64	60.05	59.62	66.19	69.05	73.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	47.34	42.05	34.20	25.89	19.35	16.34	17.65	22.95	30.80	39.11	45.64	48.66	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.02	320.31	312.02	294.37	272.10	251.16	237.17	233.88	242.17	259.82	282.10	303.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	(71)
Water heating gains (Table 5)	101.12	99.01	94.64	88.70	84.84	79.41	74.79	80.71	82.81	88.96	95.91	99.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	565.21	561.10	540.59	508.69	476.02	446.63	429.34	437.26	455.51	487.61	523.37	550.44	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	14.16	x	19.64	x 0.9 x	0.50	x	0.90	=	86.73	(76)

Solar gains in watts ∑(74)m...(82)m

86.73	169.66	279.40	407.49	499.39	511.22	486.70	418.07	324.96	201.31	108.14	71.32	(83)

Total gains - internal and solar (73)m + (83)m

651.94	730.76	819.99	916.18	975.41	957.85	916.04	855.33	780.46	688.92	631.51	621.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.76	0.58	0.40	0.29	0.32	0.53	0.83	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.47	20.61	20.79	20.95	20.99	21.00	21.00	21.00	21.00	20.92	20.68	20.44	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.24	20.24	20.24	20.25	20.26	20.27	20.27	20.27	20.26	20.26	20.25	20.25	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.96	0.89	0.73	0.53	0.36	0.24	0.27	0.48	0.80	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.55	19.74	20.00	20.20	20.25	20.27	20.27	20.27	20.26	20.18	19.85	19.52	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.93	20.10	20.32	20.50	20.55	20.57	20.57	20.57	20.56	20.48	20.19	19.90	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.93	20.10	20.32	20.50	20.55	20.57	20.57	20.57	20.56	20.48	20.19	19.90	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.89	0.74	0.55	0.37	0.26	0.29	0.50	0.81	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	636.82	697.01	730.14	678.12	536.44	358.22	238.31	249.55	389.12	556.43	600.53	610.33	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	979.77	949.78	861.17	711.19	540.82	358.47	238.33	249.59	390.81	603.57	804.98	971.50	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	255.16	169.86	97.49	23.81	3.26	0.00	0.00	0.00	0.00	35.08	147.21	268.71	

∑(98)1...5, 10...12 = 1000.57 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.05 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1000.57		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	210.12	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	840.48	(307b)

Water heating

Annual water heating requirement	1813.66		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	380.87	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1523.47	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.55	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.97		(330a)
Total electricity for the above, kWh/year		116.97	(331)
Electricity for lighting (Appendix L)		334.42	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3406.32	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	210.12	x	2.97	x 0.01 =	6.24	(340a)
Space heating from boilers	840.48	x	4.24	x 0.01 =	35.64	(340b)
Water heating from CHP	380.87	x	2.97	x 0.01 =	11.31	(342a)
Water heating from boilers	1523.47	x	4.24	x 0.01 =	64.60	(342b)
Pumps and fans	116.97	x	13.19	x 0.01 =	15.43	(349)
Electricity for lighting	334.42	x	13.19	x 0.01 =	44.11	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		297.32	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.69	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	388.7922	x	0.2160	=	83.9791	(363)
less credit emissions for electricity		-128.9075	x	0.5190	=	-66.9030	(364)
Water heated by CHP		704.7347	x	0.2160	=	152.2227	(365)
less credit emissions for electricity		-233.6611	x	0.5190	=	-121.2701	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2427.05	x	0.216	=	524.24	(368)
Electrical energy for community heat distribution		29.55	x	0.519	=	15.34	(372)
Total CO2 associated with community systems						587.61	(373)
Total CO2 associated with space and water heating						587.61	(376)
Pumps and fans		116.97	x	0.519	=	60.71	(378)
Electricity for lighting		334.42	x	0.519	=	173.56	(379)
Total CO_2, kg/year					(376)..(382) =	821.88	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.72	(384)
EI value						90.95	
EI rating (section 14)						91	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	388.79	x	1.22	=	474.33	(363)
less credit energy for electricity		-128.91	x	3.07	=	-395.75	(364)
Water heated by CHP		704.73	x	1.22	=	859.78	(365)
less credit energy for electricity		-233.66	x	3.07	=	-717.34	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2427.05	x	1.22	=	2961.00	(368)
Electrical energy for community heat distribution		29.55	x	3.07	=	90.72	(372)
Total primary energy associated with community systems						3272.74	(373)
Total primary energy associated with space and water heating						3272.74	(376)
Pumps and fans		116.97	x	3.07	=	359.09	(378)
Electricity for lighting		334.42	x	3.07	=	1026.66	(379)
Primary energy kWh/year						4658.49	(383)
Dwelling primary energy rate kWh/m2/year						60.74	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	03/07/2018
Address	Sr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		76.70	(1a) x	2.50	(2a) =	191.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	76.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	191.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.16	x	1.24	=	17.50			(27)
External wall			19.09	x	0.15	=	2.86			(29a)
Party wall			62.25	x	0.00	=	0.00			(32)
Roof			76.70	x	0.12	=	9.20			(30)
Total area of external elements ∑A, m²			109.95							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.57 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.49 (36)
Total fabric heat loss	(33) + (36) =	46.06 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
16.65	16.44	16.24	15.23	15.03	14.02	14.02	13.82	14.43	15.03	15.44	15.84	(38)

Heat transfer coefficient, W/K (37)m + (38)m

62.70	62.50	62.30	61.29	61.09	60.08	60.08	59.88	60.49	61.09	61.49	61.90	

Average = ∑(39)1...12/12 = 61.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.82	0.81	0.81	0.80	0.80	0.78	0.78	0.78	0.79	0.80	0.80	0.81	

Average = ∑(40)1...12/12 = 0.80 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.40 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		91.14 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
100.25	96.60	92.96	89.31	85.67	82.02	82.02	85.67	89.31	92.96	96.60	100.25	

∑(44)1...12 = 1093.62 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

148.67	130.02	134.17	116.98	112.24	96.86	89.75	102.99	104.22	121.46	132.58	143.97	

∑(45)1...12 = 1433.91 (45)

Distribution loss 0.15 x (45)m

22.30	19.50	20.13	17.55	16.84	14.53	13.46	15.45	15.63	18.22	19.89	21.60	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		1.00 (47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)		0.29 (48)
Temperature factor from Table 2b		1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)		0.29 (50)
Enter (50) or (54) in (55)		0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

180.92	159.16	166.43	148.19	144.49	128.07	122.00	135.24	135.43	153.71	163.79	176.23	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

180.92	159.16	166.43	148.19	144.49	128.07	122.00	135.24	135.43	153.71	163.79	176.23	

∑(64)1...12 = 1813.66 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

75.23	66.54	70.41	63.86	63.12	57.17	55.64	60.05	59.62	66.19	69.05	73.67	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	143.84	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	47.34	42.05	34.20	25.89	19.35	16.34	17.65	22.95	30.80	39.11	45.64	48.66	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.02	320.31	312.02	294.37	272.10	251.16	237.17	233.88	242.17	259.82	282.10	303.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	51.78	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	-95.89	(71)
Water heating gains (Table 5)	101.12	99.01	94.64	88.70	84.84	79.41	74.79	80.71	82.81	88.96	95.91	99.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	565.21	561.10	540.59	508.69	476.02	446.63	429.34	437.26	455.51	487.61	523.37	550.44	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	14.16	x	19.64	x 0.9 x	0.50	x	0.90	=	86.73	(76)

Solar gains in watts ∑(74)m...(82)m

86.73	169.66	279.40	407.49	499.39	511.22	486.70	418.07	324.96	201.31	108.14	71.32	(83)

Total gains - internal and solar (73)m + (83)m

651.94	730.76	819.99	916.18	975.41	957.85	916.04	855.33	780.46	688.92	631.51	621.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.96	0.91	0.76	0.58	0.40	0.29	0.32	0.53	0.83	0.96	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.47	20.61	20.79	20.95	20.99	21.00	21.00	21.00	21.00	20.92	20.68	20.44	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.24	20.24	20.24	20.25	20.26	20.27	20.27	20.27	20.26	20.26	20.25	20.25	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.98	0.96	0.89	0.73	0.53	0.36	0.24	0.27	0.48	0.80	0.95	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.55	19.74	20.00	20.20	20.25	20.27	20.27	20.27	20.26	20.18	19.85	19.52	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.93	20.10	20.32	20.50	20.55	20.57	20.57	20.57	20.56	20.48	20.19	19.90	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.93	20.10	20.32	20.50	20.55	20.57	20.57	20.57	20.56	20.48	20.19	19.90	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.89	0.74	0.55	0.37	0.26	0.29	0.50	0.81	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	636.82	697.01	730.14	678.12	536.44	358.22	238.31	249.55	389.12	556.43	600.53	610.33	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	979.77	949.78	861.17	711.19	540.82	358.47	238.33	249.59	390.81	603.57	804.98	971.50	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	255.16	169.86	97.49	23.81	3.26	0.00	0.00	0.00	0.00	35.08	147.21	268.71	

∑(98)1...5, 10...12 = 1000.57 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.05 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1000.57		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	210.12	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	840.48	(307b)

Water heating

Annual water heating requirement	1813.66		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	380.87	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1523.47	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	29.55	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	116.97		(330a)
Total electricity for the above, kWh/year		116.97	(331)
Electricity for lighting (Appendix L)		334.42	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3173.14	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	210.12	x	2.97	x 0.01 =	6.24	(340a)
Space heating from boilers	840.48	x	4.24	x 0.01 =	35.64	(340b)
Water heating from CHP	380.87	x	2.97	x 0.01 =	11.31	(342a)
Water heating from boilers	1523.47	x	4.24	x 0.01 =	64.60	(342b)
Pumps and fans	116.97	x	13.19	x 0.01 =	15.43	(349)
Electricity for lighting	334.42	x	13.19	x 0.01 =	44.11	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		297.32	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.69	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	388.7922	x	0.2160	=	83.9791	(363)
less credit emissions for electricity		-128.9075	x	0.5190	=	-66.9030	(364)
Water heated by CHP		704.7347	x	0.2160	=	152.2227	(365)
less credit emissions for electricity		-233.6611	x	0.5190	=	-121.2701	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2427.05	x	0.216	=	524.24	(368)
Electrical energy for community heat distribution		29.55	x	0.519	=	15.34	(372)
Total CO2 associated with community systems						587.61	(373)
Total CO2 associated with space and water heating						587.61	(376)
Pumps and fans		116.97	x	0.519	=	60.71	(378)
Electricity for lighting		334.42	x	0.519	=	173.56	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	700.86	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.14	(384)
EI value					92.28	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	388.79	x	1.22	=	474.33	(363)
less credit energy for electricity		-128.91	x	3.07	=	-395.75	(364)
Water heated by CHP		704.73	x	1.22	=	859.78	(365)
less credit energy for electricity		-233.66	x	3.07	=	-717.34	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2427.05	x	1.22	=	2961.00	(368)
Electrical energy for community heat distribution		29.55	x	3.07	=	90.72	(372)
Total primary energy associated with community systems						3272.74	(373)
Total primary energy associated with space and water heating						3272.74	(376)
Pumps and fans		116.97	x	3.07	=	359.09	(378)
Electricity for lighting		334.42	x	3.07	=	1026.66	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3942.63	(383)
Dwelling primary energy rate kWh/m2/year						51.40	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Tr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.20	(1a) x	2.50	(2a) =	265.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	265.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.58	x	1.24	=	15.55			(27)
External wall			43.67	x	0.15	=	6.55			(29a)
Party wall			56.25	x	0.00	=	0.00			(32)
Roof			106.20	x	0.12	=	12.74			(30)
Total area of external elements ∑A, m²			162.45							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.84 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		24.37 (36)
Total fabric heat loss	(33) + (36) =	59.21 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
23.05	22.77	22.49	21.09	20.81	19.42	19.42	19.14	19.98	20.81	21.37	21.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

82.26	81.98	81.70	80.30	80.02	78.63	78.63	78.35	79.18	80.02	80.58	81.14	

Average = ∑(39)1...12/12 = 80.23 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.77	0.77	0.77	0.76	0.75	0.74	0.74	0.74	0.75	0.75	0.76	0.76	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.79 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.46 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
110.51	106.49	102.47	98.45	94.43	90.42	90.42	94.43	98.45	102.47	106.49	110.51	

∑(44)1...12 = 1205.55 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

163.88	143.33	147.90	128.95	123.73	106.77	98.94	113.53	114.89	133.89	146.15	158.71	

∑(45)1...12 = 1580.66 (45)

Distribution loss 0.15 x (45)m

24.58	21.50	22.19	19.34	18.56	16.02	14.84	17.03	17.23	20.08	21.92	23.81	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

196.13	172.46	180.16	160.16	155.98	137.98	131.19	145.78	146.10	166.14	177.36	190.96	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

196.13	172.46	180.16	160.16	155.98	137.98	131.19	145.78	146.10	166.14	177.36	190.96	

∑(64)1...12 = 1960.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

80.29	70.96	74.98	67.84	66.94	60.47	58.70	63.55	63.17	70.32	73.56	78.57	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.47	55.48	45.12	34.16	25.53	21.56	23.29	30.28	40.64	51.60	60.23	64.20	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	396.98	401.10	390.72	368.62	340.73	314.51	296.99	292.87	303.25	325.35	353.25	379.47	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	(71)
Water heating gains (Table 5)	107.92	105.60	100.78	94.23	89.98	83.99	78.90	85.42	87.74	94.52	102.17	105.61	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	677.70	672.51	646.95	607.34	566.57	530.38	509.51	518.90	541.96	581.80	625.98	659.61	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	8.84	x	19.64	x 0.9 x	0.50	x	0.90	=	54.14	(80)
North	0.77	x	3.74	x	10.63	x 0.9 x	0.50	x	0.90	=	12.40	(74)

Solar gains in watts ∑(74)m...(82)m

66.55	129.62	214.70	319.08	398.91	412.44	390.94	330.10	251.29	153.89	82.81	54.86	(83)

Total gains - internal and solar (73)m + (83)m

744.25	802.13	861.66	926.42	965.48	942.82	900.45	848.99	793.25	735.69	708.79	714.47	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.99	0.97	0.90	0.74	0.53	0.38	0.42	0.67	0.92	0.99	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.40	20.50	20.67	20.87	20.97	21.00	21.00	21.00	20.99	20.85	20.60	20.38

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.28	20.28	20.28	20.29	20.29	20.31	20.31	20.31	20.30	20.29	20.29	20.28

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.96	0.87	0.69	0.47	0.32	0.36	0.61	0.90	0.98	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.47	19.62	19.86	20.14	20.27	20.30	20.31	20.31	20.29	20.13	19.78	19.46

(90)

Living area fraction — Living area ÷ (4) = 0.28 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.74	19.87	20.09	20.35	20.47	20.50	20.50	20.50	20.49	20.34	20.01	19.72

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.74	19.87	20.09	20.35	20.47	20.50	20.50	20.50	20.49	20.34	20.01	19.72

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.87	0.70	0.49	0.34	0.38	0.63	0.90	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	736.73	787.47	824.20	809.17	680.42	462.58	306.75	321.36	498.64	662.82	693.29	708.75	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1269.77	1227.30	1110.42	919.21	701.59	463.96	306.83	321.53	505.99	779.33	1040.27	1259.10	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	396.58	295.56	212.94	79.23	15.75	0.00	0.00	0.00	0.00	86.68	249.83	409.46	

∑(98)1...5, 10...12 = 1746.03 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.44 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1746.03		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1833.33	(307a)

Water heating

Annual water heating requirement	1960.41		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	2058.43	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	38.92	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	214.59	(330a)

Total electricity for the above, kWh/year		214.59	(331)
Electricity for lighting (Appendix L)		441.27	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4547.62	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1833.33	x	4.24	x 0.01 =	77.73	(340a)
Water heating from boilers	2058.43	x	4.24	x 0.01 =	87.28	(342a)
Pumps and fans	214.59	x	13.19	x 0.01 =	28.30	(349)
Electricity for lighting	441.27	x	13.19	x 0.01 =	58.20	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		371.52	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.03	(357)
SAP value	85.60	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3995.65	x	0.216	=	863.06	(367)
Electrical energy for community heat distribution		38.92	x	0.519	=	20.20	(372)
Total CO2 associated with community systems						883.26	(373)
Total CO2 associated with space and water heating						883.26	(376)
Pumps and fans		214.59	x	0.519	=	111.37	(378)
Electricity for lighting		441.27	x	0.519	=	229.02	(379)
Total CO_2, kg/year					(376)..(382) =	1223.65	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.52	(384)
EI value						89.16	
EI rating (section 14)						89	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3995.65	x	1.22	=	4874.69	(367)
Electrical energy for community heat distribution		38.92	x	3.07	=	119.48	(372)
Total primary energy associated with community systems						4994.17	(373)
Total primary energy associated with space and water heating						4994.17	(376)
Pumps and fans		214.59	x	3.07	=	658.79	(378)
Electricity for lighting		441.27	x	3.07	=	1354.71	(379)
Primary energy kWh/year						7007.67	(383)

DRAFT

Dwelling primary energy rate kWh/m2/year	65.99	(384)

DRAFT

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Tr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.20	(1a) x	2.50	(2a) =	265.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	265.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.58	x	1.24	=	15.55			(27)
External wall			43.67	x	0.15	=	6.55			(29a)
Party wall			56.25	x	0.00	=	0.00			(32)
Roof			106.20	x	0.12	=	12.74			(30)
Total area of external elements ∑A, m²			162.45							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.84 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		24.37 (36)
Total fabric heat loss	(33) + (36) =	59.21 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
23.05	22.77	22.49	21.09	20.81	19.42	19.42	19.14	19.98	20.81	21.37	21.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

82.26	81.98	81.70	80.30	80.02	78.63	78.63	78.35	79.18	80.02	80.58	81.14	

Average = ∑(39)1...12/12 = 80.23 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.77	0.77	0.77	0.76	0.75	0.74	0.74	0.74	0.75	0.75	0.76	0.76	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.79 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.46 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
110.51	106.49	102.47	98.45	94.43	90.42	90.42	94.43	98.45	102.47	106.49	110.51	

∑(44)1...12 = 1205.55 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

163.88	143.33	147.90	128.95	123.73	106.77	98.94	113.53	114.89	133.89	146.15	158.71	

∑(45)1...12 = 1580.66 (45)

Distribution loss 0.15 x (45)m

24.58	21.50	22.19	19.34	18.56	16.02	14.84	17.03	17.23	20.08	21.92	23.81	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

196.13	172.46	180.16	160.16	155.98	137.98	131.19	145.78	146.10	166.14	177.36	190.96	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

196.13	172.46	180.16	160.16	155.98	137.98	131.19	145.78	146.10	166.14	177.36	190.96	

∑(64)1...12 = 1960.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

80.29	70.96	74.98	67.84	66.94	60.47	58.70	63.55	63.17	70.32	73.56	78.57	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.47	55.48	45.12	34.16	25.53	21.56	23.29	30.28	40.64	51.60	60.23	64.20	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	396.98	401.10	390.72	368.62	340.73	314.51	296.99	292.87	303.25	325.35	353.25	379.47	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	(71)
Water heating gains (Table 5)	107.92	105.60	100.78	94.23	89.98	83.99	78.90	85.42	87.74	94.52	102.17	105.61	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	677.70	672.51	646.95	607.34	566.57	530.38	509.51	518.90	541.96	581.80	625.98	659.61	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	8.84	x	19.64	x 0.9 x	0.50	x	0.90	=	54.14	(80)
North	0.77	x	3.74	x	10.63	x 0.9 x	0.50	x	0.90	=	12.40	(74)

Solar gains in watts ∑(74)m...(82)m

66.55	129.62	214.70	319.08	398.91	412.44	390.94	330.10	251.29	153.89	82.81	54.86	(83)

Total gains - internal and solar (73)m + (83)m

744.25	802.13	861.66	926.42	965.48	942.82	900.45	848.99	793.25	735.69	708.79	714.47	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.99	0.97	0.90	0.74	0.53	0.38	0.42	0.67	0.92	0.99	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.40	20.50	20.67	20.87	20.97	21.00	21.00	21.00	20.99	20.85	20.60	20.38

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.28	20.28	20.28	20.29	20.29	20.31	20.31	20.31	20.30	20.29	20.29	20.28

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.96	0.87	0.69	0.47	0.32	0.36	0.61	0.90	0.98	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.47	19.62	19.86	20.14	20.27	20.30	20.31	20.31	20.29	20.13	19.78	19.46

(90)

Living area fraction — Living area ÷ (4) = 0.28 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.74	19.87	20.09	20.35	20.47	20.50	20.50	20.50	20.49	20.34	20.01	19.72

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.74	19.87	20.09	20.35	20.47	20.50	20.50	20.50	20.49	20.34	20.01	19.72

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.87	0.70	0.49	0.34	0.38	0.63	0.90	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	736.73	787.47	824.20	809.17	680.42	462.58	306.75	321.36	498.64	662.82	693.29	708.75	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1269.77	1227.30	1110.42	919.21	701.59	463.96	306.83	321.53	505.99	779.33	1040.27	1259.10	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	396.58	295.56	212.94	79.23	15.75	0.00	0.00	0.00	0.00	86.68	249.83	409.46	

∑(98)1...5, 10...12 = 1746.03 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.44 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1746.03		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	366.67	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1466.67	(307b)

Water heating

Annual water heating requirement	1960.41		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	411.69	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1646.74	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	38.92	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	214.59		(330a)
Total electricity for the above, kWh/year		214.59	(331)
Electricity for lighting (Appendix L)		441.27	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4547.62	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	366.67	x	2.97	x 0.01 =	10.89	(340a)
Space heating from boilers	1466.67	x	4.24	x 0.01 =	62.19	(340b)
Water heating from CHP	411.69	x	2.97	x 0.01 =	12.23	(342a)
Water heating from boilers	1646.74	x	4.24	x 0.01 =	69.82	(342b)
Pumps and fans	214.59	x	13.19	x 0.01 =	28.30	(349)
Electricity for lighting	441.27	x	13.19	x 0.01 =	58.20	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		361.63	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	85.99	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	678.4579	x	0.2160	=	146.5469	(363)
less credit emissions for electricity		-224.9488	x	0.5190	=	-116.7484	(364)
Water heated by CHP		761.7586	x	0.2160	=	164.5398	(365)
less credit emissions for electricity		-252.5679	x	0.5190	=	-131.0827	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3196.52	x	0.216	=	690.45	(368)
Electrical energy for community heat distribution		38.92	x	0.519	=	20.20	(372)
Total CO2 associated with community systems						773.90	(373)
Total CO2 associated with space and water heating						773.90	(376)
Pumps and fans		214.59	x	0.519	=	111.37	(378)
Electricity for lighting		441.27	x	0.519	=	229.02	(379)
Total CO_2, kg/year					(376)..(382) =	1114.30	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.49	(384)
EI value						90.12	
EI rating (section 14)						90	(385)

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EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	678.46	x	1.22	=	827.72	(363)
less credit energy for electricity		-224.95	x	3.07	=	-690.59	(364)
Water heated by CHP		761.76	x	1.22	=	929.35	(365)
less credit energy for electricity		-252.57	x	3.07	=	-775.38	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3196.52	x	1.22	=	3899.75	(368)
Electrical energy for community heat distribution		38.92	x	3.07	=	119.48	(372)
Total primary energy associated with community systems						4310.32	(373)
Total primary energy associated with space and water heating						4310.32	(376)
Pumps and fans		214.59	x	3.07	=	658.79	(378)
Electricity for lighting		441.27	x	3.07	=	1354.71	(379)
Primary energy kWh/year						6323.82	(383)
Dwelling primary energy rate kWh/m2/year						59.55	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Tr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.20	(1a) x	2.50	(2a) =	265.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	265.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		0	x 10 = 0	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) = 0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.58	x	1.24	=	15.55			(27)
External wall			43.67	x	0.15	=	6.55			(29a)
Party wall			56.25	x	0.00	=	0.00			(32)
Roof			106.20	x	0.12	=	12.74			(30)
Total area of external elements ∑A, m²			162.45							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.84 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		24.37 (36)
Total fabric heat loss	(33) + (36) =	59.21 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
23.05	22.77	22.49	21.09	20.81	19.42	19.42	19.14	19.98	20.81	21.37	21.93	(38)

Heat transfer coefficient, W/K (37)m + (38)m

82.26	81.98	81.70	80.30	80.02	78.63	78.63	78.35	79.18	80.02	80.58	81.14	

Average = ∑(39)1...12/12 = 80.23 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.77	0.77	0.77	0.76	0.75	0.74	0.74	0.74	0.75	0.75	0.76	0.76	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.79 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.46 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
110.51	106.49	102.47	98.45	94.43	90.42	90.42	94.43	98.45	102.47	106.49	110.51	

∑(44)1...12 = 1205.55 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

163.88	143.33	147.90	128.95	123.73	106.77	98.94	113.53	114.89	133.89	146.15	158.71	

∑(45)1...12 = 1580.66 (45)

Distribution loss 0.15 x (45)m

24.58	21.50	22.19	19.34	18.56	16.02	14.84	17.03	17.23	20.08	21.92	23.81	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

196.13	172.46	180.16	160.16	155.98	137.98	131.19	145.78	146.10	166.14	177.36	190.96	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

196.13	172.46	180.16	160.16	155.98	137.98	131.19	145.78	146.10	166.14	177.36	190.96	

∑(64)1...12 = 1960.41 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

80.29	70.96	74.98	67.84	66.94	60.47	58.70	63.55	63.17	70.32	73.56	78.57	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	167.40	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.47	55.48	45.12	34.16	25.53	21.56	23.29	30.28	40.64	51.60	60.23	64.20	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	396.98	401.10	390.72	368.62	340.73	314.51	296.99	292.87	303.25	325.35	353.25	379.47	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	54.53	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	-111.60	(71)
Water heating gains (Table 5)	107.92	105.60	100.78	94.23	89.98	83.99	78.90	85.42	87.74	94.52	102.17	105.61	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	677.70	672.51	646.95	607.34	566.57	530.38	509.51	518.90	541.96	581.80	625.98	659.61	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	8.84	x	19.64	x 0.9 x	0.50	x	0.90	=	54.14	(80)
North	0.77	x	3.74	x	10.63	x 0.9 x	0.50	x	0.90	=	12.40	(74)

Solar gains in watts ∑(74)m...(82)m

66.55	129.62	214.70	319.08	398.91	412.44	390.94	330.10	251.29	153.89	82.81	54.86	(83)

Total gains - internal and solar (73)m + (83)m

744.25	802.13	861.66	926.42	965.48	942.82	900.45	848.99	793.25	735.69	708.79	714.47	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.99	0.97	0.90	0.74	0.53	0.38	0.42	0.67	0.92	0.99	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.40	20.50	20.67	20.87	20.97	21.00	21.00	21.00	20.99	20.85	20.60	20.38	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.28	20.28	20.28	20.29	20.29	20.31	20.31	20.31	20.30	20.29	20.29	20.28	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.96	0.87	0.69	0.47	0.32	0.36	0.61	0.90	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.47	19.62	19.86	20.14	20.27	20.30	20.31	20.31	20.29	20.13	19.78	19.46	(90)

Living area fraction — Living area ÷ (4) = 0.28 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.74	19.87	20.09	20.35	20.47	20.50	20.50	20.50	20.49	20.34	20.01	19.72	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.74	19.87	20.09	20.35	20.47	20.50	20.50	20.50	20.49	20.34	20.01	19.72	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.87	0.70	0.49	0.34	0.38	0.63	0.90	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	736.73	787.47	824.20	809.17	680.42	462.58	306.75	321.36	498.64	662.82	693.29	708.75	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1269.77	1227.30	1110.42	919.21	701.59	463.96	306.83	321.53	505.99	779.33	1040.27	1259.10	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	396.58	295.56	212.94	79.23	15.75	0.00	0.00	0.00	0.00	86.68	249.83	409.46	

∑(98)1...5, 10...12 = 1746.03 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 16.44 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1746.03		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	366.67	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	1466.67	(307b)

Water heating

Annual water heating requirement	1960.41		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	411.69	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1646.74	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	38.92	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	214.59		(330a)
Total electricity for the above, kWh/year		214.59	(331)
Electricity for lighting (Appendix L)		441.27	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4314.45	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	366.67	x	2.97	x 0.01 =	10.89	(340a)
Space heating from boilers	1466.67	x	4.24	x 0.01 =	62.19	(340b)
Water heating from CHP	411.69	x	2.97	x 0.01 =	12.23	(342a)
Water heating from boilers	1646.74	x	4.24	x 0.01 =	69.82	(342b)
Pumps and fans	214.59	x	13.19	x 0.01 =	28.30	(349)
Electricity for lighting	441.27	x	13.19	x 0.01 =	58.20	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		361.63	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	85.99	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	678.4579	x	0.2160	=	146.5469	(363)
less credit emissions for electricity		-224.9488	x	0.5190	=	-116.7484	(364)
Water heated by CHP		761.7586	x	0.2160	=	164.5398	(365)
less credit emissions for electricity		-252.5679	x	0.5190	=	-131.0827	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3196.52	x	0.216	=	690.45	(368)
Electrical energy for community heat distribution		38.92	x	0.519	=	20.20	(372)
Total CO2 associated with community systems						773.90	(373)
Total CO2 associated with space and water heating						773.90	(376)
Pumps and fans		214.59	x	0.519	=	111.37	(378)
Electricity for lighting		441.27	x	0.519	=	229.02	(379)

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Energy saving/generation technologies						
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	993.28	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.35	(384)
EI value					91.20	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	678.46	x	1.22	=	827.72	(363)
less credit energy for electricity		-224.95	x	3.07	=	-690.59	(364)
Water heated by CHP		761.76	x	1.22	=	929.35	(365)
less credit energy for electricity		-252.57	x	3.07	=	-775.38	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	3196.52	x	1.22	=	3899.75	(368)
Electrical energy for community heat distribution		38.92	x	3.07	=	119.48	(372)
Total primary energy associated with community systems						4310.32	(373)
Total primary energy associated with space and water heating						4310.32	(376)
Pumps and fans		214.59	x	3.07	=	658.79	(378)
Electricity for lighting		441.27	x	3.07	=	1354.71	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						5607.97	(383)
Dwelling primary energy rate kWh/m2/year						52.81	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ur 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.70	(1a) x	2.50	(2a) =	181.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	181.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.22	x	1.24	=	15.10			(27)
External wall			14.03	x	0.15	=	2.10			(29a)
Party wall			68.75	x	0.00	=	0.00			(32)
Roof			72.70	x	0.12	=	8.72			(30)
Total area of external elements ∑A, m²			98.95							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	25.93 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.84 (36)
Total fabric heat loss	(33) + (36) =	40.77 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.78	15.59	15.40	14.44	14.25	13.29	13.29	13.10	13.67	14.25	14.63	15.01	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.55	56.36	56.17	55.21	55.02	54.06	54.06	53.87	54.45	55.02	55.40	55.78	

Average = ∑(39)1...12/12 = 55.16 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.78	0.78	0.77	0.76	0.76	0.74	0.74	0.74	0.75	0.76	0.76	0.77	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.31 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.96	94.40	90.84	87.28	83.72	80.15	80.15	83.72	87.28	90.84	94.40	97.96	

∑(44)1...12 = 1068.71 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.28	127.06	131.12	114.31	109.68	94.65	87.71	100.64	101.85	118.69	129.56	140.69	

∑(45)1...12 = 1401.24 (45)

Distribution loss 0.15 x (45)m

21.79	19.06	19.67	17.15	16.45	14.20	13.16	15.10	15.28	17.80	19.43	21.10	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.53	156.19	163.37	145.52	141.94	125.86	119.96	132.90	133.06	150.94	160.77	172.95	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.53	156.19	163.37	145.52	141.94	125.86	119.96	132.90	133.06	150.94	160.77	172.95	

∑(64)1...12 = 1780.99 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.11	65.55	69.40	62.98	62.27	56.44	54.96	59.27	58.83	65.27	68.05	72.58	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.41	40.33	32.80	24.83	18.56	15.67	16.93	22.01	29.54	37.51	43.78	46.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	303.75	306.91	298.96	282.05	260.71	240.65	227.24	224.09	232.03	248.94	270.29	290.35	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	(71)
Water heating gains (Table 5)	99.61	97.55	93.28	87.47	83.70	78.39	73.88	79.66	81.71	87.72	94.51	97.56	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	546.13	542.15	522.40	491.72	460.33	432.07	415.42	423.12	440.65	471.54	505.94	531.94	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.22	x	36.79	x 0.9 x	0.50	x	0.90	=	140.21	(79)

Solar gains in watts ∑(74)m...(82)m

140.21	238.84	326.79	404.90	453.53	450.25	434.09	397.81	353.84	263.97	167.94	119.99	(83)

Total gains - internal and solar (73)m + (83)m

686.35	780.99	849.19	896.62	913.86	882.32	849.50	820.94	794.49	735.51	673.89	651.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.93	0.86	0.72	0.56	0.39	0.28	0.30	0.47	0.74	0.93	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.61	20.75	20.88	20.97	20.99	21.00	21.00	21.00	21.00	20.97	20.80	20.58	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.27	20.27	20.28	20.29	20.29	20.30	20.30	20.30	20.30	20.29	20.29	20.28	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.92	0.83	0.68	0.51	0.35	0.24	0.26	0.42	0.70	0.91	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.78	19.97	20.14	20.26	20.29	20.30	20.30	20.30	20.30	20.26	20.05	19.74	(90)

Living area fraction — Living area ÷ (4) = 0.47 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

20.17	20.34	20.49	20.59	20.62	20.63	20.63	20.63	20.63	20.59	20.40	20.14	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.17	20.34	20.49	20.59	20.62	20.63	20.63	20.63	20.63	20.59	20.40	20.14	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.92	0.84	0.70	0.53	0.37	0.26	0.28	0.45	0.72	0.91	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	657.97	715.73	711.94	626.66	488.11	325.95	217.98	228.05	354.85	530.48	614.34	630.56	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	897.51	869.96	785.67	645.55	490.86	326.11	217.99	228.06	355.46	549.80	736.90	889.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	178.22	103.65	54.86	13.60	2.04	0.00	0.00	0.00	0.00	14.37	88.24	192.37	

∑(98)1...5, 10...12 = 647.35 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.90 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	647.35		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	679.71	(307a)

Water heating

Annual water heating requirement	1780.99		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1870.04	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.50	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	119.18		(330a)
Total electricity for the above, kWh/year		119.18	(331)

Electricity for lighting (Appendix L)		320.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2989.69	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	679.71	x	4.24	x 0.01 =	28.82	(340a)
Water heating from boilers	1870.04	x	4.24	x 0.01 =	79.29	(342a)
Pumps and fans	119.18	x	13.19	x 0.01 =	15.72	(349)
Electricity for lighting	320.76	x	13.19	x 0.01 =	42.31	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		286.14	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.02	(357)
SAP value	85.76	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2617.82	x	0.216	=	565.45	(367)
Electrical energy for community heat distribution	25.50	x	0.519	=	13.23	(372)
Total CO2 associated with community systems					578.68	(373)
Total CO2 associated with space and water heating					578.68	(376)
Pumps and fans	119.18	x	0.519	=	61.86	(378)
Electricity for lighting	320.76	x	0.519	=	166.47	(379)
Total CO_2, kg/year				(376)..(382) =	807.01	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.10	(384)
EI value					90.81	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	97.40					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2617.82	x	1.22	=	3193.74	(367)
Electrical energy for community heat distribution	25.50	x	3.07	=	78.28	(372)
Total primary energy associated with community systems					3272.01	(373)
Total primary energy associated with space and water heating					3272.01	(376)
Pumps and fans	119.18	x	3.07	=	365.89	(378)
Electricity for lighting	320.76	x	3.07	=	984.72	(379)
Primary energy kWh/year					4622.63	(383)
Dwelling primary energy rate kWh/m2/year					63.58	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ur 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.70	(1a) x	2.50	(2a) =	181.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	181.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.22	x	1.24	=	15.10			(27)
External wall			14.03	x	0.15	=	2.10			(29a)
Party wall			68.75	x	0.00	=	0.00			(32)
Roof			72.70	x	0.12	=	8.72			(30)
Total area of external elements ∑A, m²			98.95							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	25.93 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.84 (36)
Total fabric heat loss	(33) + (36) =	40.77 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.78	15.59	15.40	14.44	14.25	13.29	13.29	13.10	13.67	14.25	14.63	15.01	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.55	56.36	56.17	55.21	55.02	54.06	54.06	53.87	54.45	55.02	55.40	55.78	

Average = ∑(39)1...12/12 = 55.16 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.78	0.78	0.77	0.76	0.76	0.74	0.74	0.74	0.75	0.76	0.76	0.77	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.31 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.96	94.40	90.84	87.28	83.72	80.15	80.15	83.72	87.28	90.84	94.40	97.96	

∑(44)1...12 = 1068.71 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.28	127.06	131.12	114.31	109.68	94.65	87.71	100.64	101.85	118.69	129.56	140.69	

∑(45)1...12 = 1401.24 (45)

Distribution loss 0.15 x (45)m

21.79	19.06	19.67	17.15	16.45	14.20	13.16	15.10	15.28	17.80	19.43	21.10	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.53	156.19	163.37	145.52	141.94	125.86	119.96	132.90	133.06	150.94	160.77	172.95	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.53	156.19	163.37	145.52	141.94	125.86	119.96	132.90	133.06	150.94	160.77	172.95	

∑(64)1...12 = 1780.99 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.11	65.55	69.40	62.98	62.27	56.44	54.96	59.27	58.83	65.27	68.05	72.58	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.41	40.33	32.80	24.83	18.56	15.67	16.93	22.01	29.54	37.51	43.78	46.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	303.75	306.91	298.96	282.05	260.71	240.65	227.24	224.09	232.03	248.94	270.29	290.35	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	(71)
Water heating gains (Table 5)	99.61	97.55	93.28	87.47	83.70	78.39	73.88	79.66	81.71	87.72	94.51	97.56	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	546.13	542.15	522.40	491.72	460.33	432.07	415.42	423.12	440.65	471.54	505.94	531.94	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.22	x	36.79	x 0.9 x	0.50	x	0.90	=	140.21	(79)

Solar gains in watts ∑(74)m...(82)m

140.21	238.84	326.79	404.90	453.53	450.25	434.09	397.81	353.84	263.97	167.94	119.99	(83)

Total gains - internal and solar (73)m + (83)m

686.35	780.99	849.19	896.62	913.86	882.32	849.50	820.94	794.49	735.51	673.89	651.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.93	0.86	0.72	0.56	0.39	0.28	0.30	0.47	0.74	0.93	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.61	20.75	20.88	20.97	20.99	21.00	21.00	21.00	21.00	20.97	20.80	20.58	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.27	20.27	20.28	20.29	20.29	20.30	20.30	20.30	20.30	20.29	20.29	20.28	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.96	0.92	0.83	0.68	0.51	0.35	0.24	0.26	0.42	0.70	0.91	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.78	19.97	20.14	20.26	20.29	20.30	20.30	20.30	20.30	20.26	20.05	19.74	(90)

Living area fraction — Living area ÷ (4) = 0.47 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.17	20.34	20.49	20.59	20.62	20.63	20.63	20.63	20.63	20.59	20.40	20.14	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.17	20.34	20.49	20.59	20.62	20.63	20.63	20.63	20.63	20.59	20.40	20.14	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.92	0.84	0.70	0.53	0.37	0.26	0.28	0.45	0.72	0.91	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	657.97	715.73	711.94	626.66	488.11	325.95	217.98	228.05	354.85	530.48	614.34	630.56	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	897.51	869.96	785.67	645.55	490.86	326.11	217.99	228.06	355.46	549.80	736.90	889.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	178.22	103.65	54.86	13.60	2.04	0.00	0.00	0.00	0.00	14.37	88.24	192.37	

∑(98)1...5, 10...12 = 647.35 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.90 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	647.35		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	135.94	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	543.77	(307b)

Water heating

Annual water heating requirement	1780.99		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	374.01	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1496.03	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.50	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	119.18		(330a)
Total electricity for the above, kWh/year		119.18	(331)
Electricity for lighting (Appendix L)		320.76	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2989.69	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	135.94	x	2.97	x 0.01 =	4.04	(340a)
Space heating from boilers	543.77	x	4.24	x 0.01 =	23.06	(340b)
Water heating from CHP	374.01	x	2.97	x 0.01 =	11.11	(342a)
Water heating from boilers	1496.03	x	4.24	x 0.01 =	63.43	(342b)
Pumps and fans	119.18	x	13.19	x 0.01 =	15.72	(349)
Electricity for lighting	320.76	x	13.19	x 0.01 =	42.31	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		279.66	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	86.08	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	251.5407	x	0.2160	=	54.3328	(363)
less credit emissions for electricity		-83.4006	x	0.5190	=	-43.2849	(364)
Water heated by CHP		692.0419	x	0.2160	=	149.4811	(365)
less credit emissions for electricity		-229.4527	x	0.5190	=	-119.0859	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2094.25	x	0.216	=	452.36	(368)
Electrical energy for community heat distribution		25.50	x	0.519	=	13.23	(372)
Total CO2 associated with community systems						507.04	(373)
Total CO2 associated with space and water heating						507.04	(376)
Pumps and fans		119.18	x	0.519	=	61.86	(378)
Electricity for lighting		320.76	x	0.519	=	166.47	(379)
Total CO_2, kg/year					(376)..(382) =	735.36	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	10.12	(384)
EI value						91.63	
EI rating (section 14)						92	(385)
EI band						A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	251.54	x	1.22	=	306.88	(363)
less credit energy for electricity		-83.40	x	3.07	=	-256.04	(364)
Water heated by CHP		692.04	x	1.22	=	844.29	(365)
less credit energy for electricity		-229.45	x	3.07	=	-704.42	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2094.25	x	1.22	=	2554.99	(368)
Electrical energy for community heat distribution		25.50	x	3.07	=	78.28	(372)
Total primary energy associated with community systems						2823.98	(373)
Total primary energy associated with space and water heating						2823.98	(376)
Pumps and fans		119.18	x	3.07	=	365.89	(378)
Electricity for lighting		320.76	x	3.07	=	984.72	(379)
Primary energy kWh/year						4174.59	(383)
Dwelling primary energy rate kWh/m2/year						57.42	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Ur 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.70	(1a) x	2.50	(2a) =	181.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	181.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.22	x	1.24	=	15.10			(27)
External wall			14.03	x	0.15	=	2.10			(29a)
Party wall			68.75	x	0.00	=	0.00			(32)
Roof			72.70	x	0.12	=	8.72			(30)
Total area of external elements ∑A, m²			98.95							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	25.93 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.84 (36)
Total fabric heat loss	(33) + (36) =	40.77 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.78	15.59	15.40	14.44	14.25	13.29	13.29	13.10	13.67	14.25	14.63	15.01	(38)

Heat transfer coefficient, W/K (37)m + (38)m

56.55	56.36	56.17	55.21	55.02	54.06	54.06	53.87	54.45	55.02	55.40	55.78	

Average = ∑(39)1...12/12 = 55.16 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.78	0.78	0.77	0.76	0.76	0.74	0.74	0.74	0.75	0.76	0.76	0.77	

Average = ∑(40)1...12/12 = 0.76 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.31 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.06 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
97.96	94.40	90.84	87.28	83.72	80.15	80.15	83.72	87.28	90.84	94.40	97.96	

∑(44)1...12 = 1068.71 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

145.28	127.06	131.12	114.31	109.68	94.65	87.71	100.64	101.85	118.69	129.56	140.69	

∑(45)1...12 = 1401.24 (45)

Distribution loss 0.15 x (45)m

21.79	19.06	19.67	17.15	16.45	14.20	13.16	15.10	15.28	17.80	19.43	21.10	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

177.53	156.19	163.37	145.52	141.94	125.86	119.96	132.90	133.06	150.94	160.77	172.95	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

177.53	156.19	163.37	145.52	141.94	125.86	119.96	132.90	133.06	150.94	160.77	172.95	

∑(64)1...12 = 1780.99 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

74.11	65.55	69.40	62.98	62.27	56.44	54.96	59.27	58.83	65.27	68.05	72.58	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	138.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.41	40.33	32.80	24.83	18.56	15.67	16.93	22.01	29.54	37.51	43.78	46.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	303.75	306.91	298.96	282.05	260.71	240.65	227.24	224.09	232.03	248.94	270.29	290.35	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	51.17	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	-92.39	(71)
Water heating gains (Table 5)	99.61	97.55	93.28	87.47	83.70	78.39	73.88	79.66	81.71	87.72	94.51	97.56	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	546.13	542.15	522.40	491.72	460.33	432.07	415.42	423.12	440.65	471.54	505.94	531.94	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	12.22	x	36.79	x 0.9 x	0.50	x	0.90	=	140.21	(79)

Solar gains in watts ∑(74)m...(82)m

140.21	238.84	326.79	404.90	453.53	450.25	434.09	397.81	353.84	263.97	167.94	119.99	(83)

Total gains - internal and solar (73)m + (83)m

686.35	780.99	849.19	896.62	913.86	882.32	849.50	820.94	794.49	735.51	673.89	651.94	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.93	0.86	0.72	0.56	0.39	0.28	0.30	0.47	0.74	0.93	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.61	20.75	20.88	20.97	20.99	21.00	21.00	21.00	21.00	20.97	20.80	20.58	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.27	20.27	20.28	20.29	20.29	20.30	20.30	20.30	20.30	20.29	20.29	20.28	(88)

Utilisation factor for gains for rest of dwelling n2,m

	0.96	0.92	0.83	0.68	0.51	0.35	0.24	0.26	0.42	0.70	0.91	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.78	19.97	20.14	20.26	20.29	20.30	20.30	20.30	20.30	20.26	20.05	19.74	(90)

Living area fraction — Living area ÷ (4) = 0.47 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	20.17	20.34	20.49	20.59	20.62	20.63	20.63	20.63	20.63	20.59	20.40	20.14	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	20.17	20.34	20.49	20.59	20.62	20.63	20.63	20.63	20.63	20.59	20.40	20.14	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.92	0.84	0.70	0.53	0.37	0.26	0.28	0.45	0.72	0.91	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	657.97	715.73	711.94	626.66	488.11	325.95	217.98	228.05	354.85	530.48	614.34	630.56	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	897.51	869.96	785.67	645.55	490.86	326.11	217.99	228.06	355.46	549.80	736.90	889.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	178.22	103.65	54.86	13.60	2.04	0.00	0.00	0.00	0.00	14.37	88.24	192.37	

∑(98)1...5, 10...12 = 647.35 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 8.90 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	647.35		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	135.94	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	543.77	(307b)

Water heating

Annual water heating requirement	1780.99		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	374.01	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1496.03	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	25.50	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	119.18		(330a)
Total electricity for the above, kWh/year		119.18	(331)
Electricity for lighting (Appendix L)		320.76	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2756.52	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	135.94	x	2.97	x 0.01 =	4.04	(340a)
Space heating from boilers	543.77	x	4.24	x 0.01 =	23.06	(340b)
Water heating from CHP	374.01	x	2.97	x 0.01 =	11.11	(342a)
Water heating from boilers	1496.03	x	4.24	x 0.01 =	63.43	(342b)
Pumps and fans	119.18	x	13.19	x 0.01 =	15.72	(349)
Electricity for lighting	320.76	x	13.19	x 0.01 =	42.31	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		279.66	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.00	(357)
SAP value	86.08	
SAP rating (section 13)	86	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	251.5407	x	0.2160	=	54.3328	(363)
less credit emissions for electricity		-83.4006	x	0.5190	=	-43.2849	(364)
Water heated by CHP		692.0419	x	0.2160	=	149.4811	(365)
less credit emissions for electricity		-229.4527	x	0.5190	=	-119.0859	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2094.25	x	0.216	=	452.36	(368)
Electrical energy for community heat distribution		25.50	x	0.519	=	13.23	(372)
Total CO2 associated with community systems						507.04	(373)
Total CO2 associated with space and water heating						507.04	(376)
Pumps and fans		119.18	x	0.519	=	61.86	(378)
Electricity for lighting		320.76	x	0.519	=	166.47	(379)
Energy saving/generation technologies							

pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	614.34	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	8.45	(384)
EI value					93.01	
EI rating (section 14)					93	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	251.54	x	1.22	=	306.88	(363)
less credit energy for electricity		-83.40	x	3.07	=	-256.04	(364)
Water heated by CHP		692.04	x	1.22	=	844.29	(365)
less credit energy for electricity		-229.45	x	3.07	=	-704.42	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2094.25	x	1.22	=	2554.99	(368)
Electrical energy for community heat distribution		25.50	x	3.07	=	78.28	(372)
Total primary energy associated with community systems						2823.98	(373)
Total primary energy associated with space and water heating						2823.98	(376)
Pumps and fans		119.18	x	3.07	=	365.89	(378)
Electricity for lighting		320.76	x	3.07	=	984.72	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3458.74	(383)
Dwelling primary energy rate kWh/m2/year						47.58	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Vr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.60	(1a) x	2.50	(2a) =	176.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.60	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	176.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			22.49	x	1.24	=	27.79			(27)
External wall			17.51	x	0.15	=	2.63			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Roof			70.60	x	0.12	=	8.47			(30)
Total area of external elements ∑A, m²			110.60							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	38.89 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.59 (36)
Total fabric heat loss	(33) + (36) =	55.48 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.32	15.14	14.95	14.02	13.84	12.91	12.91	12.72	13.28	13.84	14.21	14.58	(38)

Heat transfer coefficient, W/K (37)m + (38)m

70.80	70.62	70.43	69.50	69.32	68.39	68.39	68.20	68.76	69.32	69.69	70.06	

Average = ∑(39)1...12/12 = 69.46 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	1.00	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.99	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.26 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	87.89 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.68	93.16	89.65	86.13	82.62	79.10	79.10	82.62	86.13	89.65	93.16	96.68	

∑(44)1...12 = 1054.67 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.37	125.39	129.39	112.81	108.24	93.41	86.55	99.32	100.51	117.13	127.86	138.85	

∑(45)1...12 = 1382.84 (45)

Distribution loss 0.15 x (45)m

21.51	18.81	19.41	16.92	16.24	14.01	12.98	14.90	15.08	17.57	19.18	20.83	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.62	154.52	161.65	144.02	140.50	124.62	118.81	131.57	131.72	149.39	159.07	171.10	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.62	154.52	161.65	144.02	140.50	124.62	118.81	131.57	131.72	149.39	159.07	171.10	

∑(64)1...12 = 1762.59 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.47	65.00	68.83	62.48	61.79	56.03	54.58	58.83	58.39	64.75	67.48	71.97	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.28	39.33	31.99	24.22	18.10	15.28	16.51	21.46	28.81	36.58	42.70	45.51	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.56	299.63	291.88	275.37	254.53	234.94	221.86	218.78	226.54	243.05	263.89	283.47	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	(71)
Water heating gains (Table 5)	98.75	96.72	92.51	86.78	83.05	77.82	73.36	79.07	81.10	87.03	93.73	96.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	535.63	531.73	512.41	482.40	451.72	424.08	407.77	415.35	432.48	462.69	496.34	521.76	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	9.82	x	19.64	x 0.9 x	0.50	x	0.90	=	60.15	(76)
South	0.77	x	12.67	x	46.75	x 0.9 x	0.50	x	0.90	=	184.72	(78)

Solar gains in watts ∑(74)m...(82)m

244.87	420.19	579.14	718.15	800.20	791.32	764.30	704.39	627.92	465.92	293.96	209.08	(83)

Total gains - internal and solar (73)m + (83)m

780.50	951.92	1091.55	1200.55	1251.93	1215.40	1172.07	1119.74	1060.40	928.61	790.30	730.83	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.91	0.82	0.67	0.51	0.36	0.26	0.28	0.44	0.73	0.92	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.41	20.63	20.83	20.95	20.99	21.00	21.00	21.00	21.00	20.94	20.67	20.36	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

20.08	20.08	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.09	20.09	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.89	0.79	0.63	0.46	0.31	0.20	0.23	0.39	0.68	0.90	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.34	19.64	19.89	20.05	20.09	20.11	20.11	20.11	20.10	20.04	19.71	19.27	(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.74	20.01	20.24	20.38	20.43	20.44	20.44	20.44	20.44	20.37	20.07	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.74	20.01	20.24	20.38	20.43	20.44	20.44	20.44	20.44	20.37	20.07	19.68	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.89	0.79	0.64	0.48	0.33	0.22	0.25	0.41	0.69	0.90	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	742.77	850.17	866.60	770.22	599.87	398.95	262.61	275.61	434.06	643.06	712.18	703.37	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1093.00	1067.07	967.71	798.09	604.80	399.38	262.65	275.67	435.60	677.39	903.55	1084.40	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	260.57	145.76	75.22	20.07	3.66	0.00	0.00	0.00	0.00	25.55	137.79	283.48	

∑(98)1...5, 10...12 = 952.10 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	952.10		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	999.71	(307a)

Water heating

Annual water heating requirement	1762.59		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	1850.72	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.50	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	115.74	(330a)

Total electricity for the above, kWh/year		115.74	(331)
Electricity for lighting (Appendix L)		312.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3278.99	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	999.71	x	4.24	x 0.01 =	42.39	(340a)
Water heating from boilers	1850.72	x	4.24	x 0.01 =	78.47	(342a)
Pumps and fans	115.74	x	13.19	x 0.01 =	15.27	(349)
Electricity for lighting	312.83	x	13.19	x 0.01 =	41.26	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		297.39	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.93	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2926.51	x	0.216	=	632.13	(367)
Electrical energy for community heat distribution		28.50	x	0.519	=	14.79	(372)
Total CO2 associated with community systems						646.92	(373)
Total CO2 associated with space and water heating						646.92	(376)
Pumps and fans		115.74	x	0.519	=	60.07	(378)
Electricity for lighting		312.83	x	0.519	=	162.36	(379)
Total CO_2, kg/year					(376)..(382) =	869.35	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	12.31	(384)
EI value						89.92	
EI rating (section 14)						90	(385)
EI band						B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2926.51	x	1.22	=	3570.35	(367)
Electrical energy for community heat distribution		28.50	x	3.07	=	87.51	(372)
Total primary energy associated with community systems						3657.86	(373)
Total primary energy associated with space and water heating						3657.86	(376)
Pumps and fans		115.74	x	3.07	=	355.32	(378)
Electricity for lighting		312.83	x	3.07	=	960.38	(379)
Primary energy kWh/year						4973.56	(383)

Dwelling primary energy rate kWh/m2/year	70.45	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Vr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.60	(1a) x	2.50	(2a) =	176.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.60	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	176.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			22.49	x	1.24	=	27.79			(27)
External wall			17.51	x	0.15	=	2.63			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Roof			70.60	x	0.12	=	8.47			(30)
Total area of external elements ∑A, m²			110.60							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	38.89 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.59 (36)
Total fabric heat loss	(33) + (36) =	55.48 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.32	15.14	14.95	14.02	13.84	12.91	12.91	12.72	13.28	13.84	14.21	14.58	(38)

Heat transfer coefficient, W/K (37)m + (38)m

70.80	70.62	70.43	69.50	69.32	68.39	68.39	68.20	68.76	69.32	69.69	70.06	

Average = ∑(39)1...12/12 = 69.46 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	1.00	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.99	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N 2.26 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.89 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.68	93.16	89.65	86.13	82.62	79.10	79.10	82.62	86.13	89.65	93.16	96.68	

∑(44)1...12 = 1054.67 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.37	125.39	129.39	112.81	108.24	93.41	86.55	99.32	100.51	117.13	127.86	138.85	

∑(45)1...12 = 1382.84 (45)

Distribution loss 0.15 x (45)m

21.51	18.81	19.41	16.92	16.24	14.01	12.98	14.90	15.08	17.57	19.18	20.83	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel 1.00 (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day) 0.29 (48)

Temperature factor from Table 2b 1.00 (49)

Energy lost from water storage (kWh/day) (48) x (49) 0.29 (50)

Enter (50) or (54) in (55) 0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.62	154.52	161.65	144.02	140.50	124.62	118.81	131.57	131.72	149.39	159.07	171.10	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.62	154.52	161.65	144.02	140.50	124.62	118.81	131.57	131.72	149.39	159.07	171.10	

∑(64)1...12 = 1762.59 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.47	65.00	68.83	62.48	61.79	56.03	54.58	58.83	58.39	64.75	67.48	71.97	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.28	39.33	31.99	24.22	18.10	15.28	16.51	21.46	28.81	36.58	42.70	45.51	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.56	299.63	291.88	275.37	254.53	234.94	221.86	218.78	226.54	243.05	263.89	283.47	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	(71)
Water heating gains (Table 5)	98.75	96.72	92.51	86.78	83.05	77.82	73.36	79.07	81.10	87.03	93.73	96.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	535.63	531.73	512.41	482.40	451.72	424.08	407.77	415.35	432.48	462.69	496.34	521.76	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	9.82	x	19.64	x 0.9 x	0.50	x	0.90	=	60.15	(76)
South	0.77	x	12.67	x	46.75	x 0.9 x	0.50	x	0.90	=	184.72	(78)

Solar gains in watts ∑(74)m...(82)m

244.87	420.19	579.14	718.15	800.20	791.32	764.30	704.39	627.92	465.92	293.96	209.08	(83)

Total gains - internal and solar (73)m + (83)m

780.50	951.92	1091.55	1200.55	1251.93	1215.40	1172.07	1119.74	1060.40	928.61	790.30	730.83	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.91	0.82	0.67	0.51	0.36	0.26	0.28	0.44	0.73	0.92	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

	20.41	20.63	20.83	20.95	20.99	21.00	21.00	21.00	21.00	20.94	20.67	20.36 (87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)

	20.08	20.08	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.09	20.09 (88)

Utilisation factor for gains for rest of dwelling n2,m

	0.96	0.89	0.79	0.63	0.46	0.31	0.20	0.23	0.39	0.68	0.90	0.97 (89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

	19.34	19.64	19.89	20.05	20.09	20.11	20.11	20.11	20.10	20.04	19.71	19.27 (90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	19.74	20.01	20.24	20.38	20.43	20.44	20.44	20.44	20.44	20.37	20.07	19.68 (92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

	19.74	20.01	20.24	20.38	20.43	20.44	20.44	20.44	20.44	20.37	20.07	19.68 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.89	0.79	0.64	0.48	0.33	0.22	0.25	0.41	0.69	0.90	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	742.77	850.17	866.60	770.22	599.87	398.95	262.61	275.61	434.06	643.06	712.18	703.37	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1093.00	1067.07	967.71	798.09	604.80	399.38	262.65	275.67	435.60	677.39	903.55	1084.40	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	260.57	145.76	75.22	20.07	3.66	0.00	0.00	0.00	0.00	25.55	137.79	283.48	

∑(98)1...5, 10...12 = 952.10 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	952.10		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	199.94	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	799.77	(307b)

Water heating

Annual water heating requirement	1762.59		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.14	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1480.57	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.50	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	115.74		(330a)
Total electricity for the above, kWh/year		115.74	(331)
Electricity for lighting (Appendix L)		312.83	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3278.99	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	199.94	x	2.97	x 0.01 =	5.94	(340a)
Space heating from boilers	799.77	x	4.24	x 0.01 =	33.91	(340b)
Water heating from CHP	370.14	x	2.97	x 0.01 =	10.99	(342a)
Water heating from boilers	1480.57	x	4.24	x 0.01 =	62.78	(342b)
Pumps and fans	115.74	x	13.19	x 0.01 =	15.27	(349)
Electricity for lighting	312.83	x	13.19	x 0.01 =	41.26	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		290.15	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.29	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	369.9601	x	0.2160	=	79.9114	(363)
less credit emissions for electricity		-122.6636	x	0.5190	=	-63.6624	(364)
Water heated by CHP		684.8912	x	0.2160	=	147.9365	(365)
less credit emissions for electricity		-227.0818	x	0.5190	=	-117.8555	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2341.21	x	0.216	=	505.70	(368)
Electrical energy for community heat distribution		28.50	x	0.519	=	14.79	(372)
Total CO2 associated with community systems						566.83	(373)
Total CO2 associated with space and water heating						566.83	(376)
Pumps and fans		115.74	x	0.519	=	60.07	(378)
Electricity for lighting		312.83	x	0.519	=	162.36	(379)
Total CO_2, kg/year					(376)..(382) =	789.25	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	11.18	(384)
EI value						90.85	
EI rating (section 14)						91	(385)

EI band	B

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	369.96	x	1.22	=	451.35	(363)
less credit energy for electricity		-122.66	x	3.07	=	-376.58	(364)
Water heated by CHP		684.89	x	1.22	=	835.57	(365)
less credit energy for electricity		-227.08	x	3.07	=	-697.14	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2341.21	x	1.22	=	2856.28	(368)
Electrical energy for community heat distribution		28.50	x	3.07	=	87.51	(372)
Total primary energy associated with community systems						3156.99	(373)
Total primary energy associated with space and water heating						3156.99	(376)
Pumps and fans		115.74	x	3.07	=	355.32	(378)
Electricity for lighting		312.83	x	3.07	=	960.38	(379)
Primary energy kWh/year						4472.69	(383)
Dwelling primary energy rate kWh/m2/year						63.35	(384)

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SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Spyridon Karnezis	Assessor number	8658
Client		Last modified	13/06/2018
Address	Vr 43-67 High Street , West Drayton , UB7 7QQ		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		70.60	(1a) x	2.50	(2a) =	176.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	70.60	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	176.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			22.49	x	1.24	=	27.79			(27)
External wall			17.51	x	0.15	=	2.63			(29a)
Party wall			47.50	x	0.00	=	0.00			(32)
Roof			70.60	x	0.12	=	8.47			(30)
Total area of external elements ∑A, m²			110.60							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	38.89 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.59 (36)
Total fabric heat loss	(33) + (36) =	55.48 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
15.32	15.14	14.95	14.02	13.84	12.91	12.91	12.72	13.28	13.84	14.21	14.58	(38)

Heat transfer coefficient, W/K (37)m + (38)m

70.80	70.62	70.43	69.50	69.32	68.39	68.39	68.20	68.76	69.32	69.69	70.06	

Average = ∑(39)1...12/12 = 69.46 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.00	1.00	1.00	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.99	0.99	

Average = ∑(40)1...12/12 = 0.98 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.26 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	87.89 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
96.68	93.16	89.65	86.13	82.62	79.10	79.10	82.62	86.13	89.65	93.16	96.68	

∑(44)1...12 = 1054.67 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

143.37	125.39	129.39	112.81	108.24	93.41	86.55	99.32	100.51	117.13	127.86	138.85	

∑(45)1...12 = 1382.84 (45)

Distribution loss 0.15 x (45)m

21.51	18.81	19.41	16.92	16.24	14.01	12.98	14.90	15.08	17.57	19.18	20.83	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	1.00 (47)
Water storage loss:	
a) If manufacturer's declared loss factor is known (kWh/day)	0.29 (48)
Temperature factor from Table 2b	1.00 (49)
Energy lost from water storage (kWh/day) (48) x (49)	0.29 (50)
Enter (50) or (54) in (55)	0.29 (55)

Water storage loss calculated for each month (55) x (41)m

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

8.99	8.12	8.99	8.70	8.99	8.70	8.99	8.99	8.70	8.99	8.70	8.99	(57)

Primary circuit loss for each month from Table 3

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23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

175.62	154.52	161.65	144.02	140.50	124.62	118.81	131.57	131.72	149.39	159.07	171.10	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

175.62	154.52	161.65	144.02	140.50	124.62	118.81	131.57	131.72	149.39	159.07	171.10	

∑(64)1...12 = 1762.59 (64)

Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

73.47	65.00	68.83	62.48	61.79	56.03	54.58	58.83	58.39	64.75	67.48	71.97	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	135.64	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.28	39.33	31.99	24.22	18.10	15.28	16.51	21.46	28.81	36.58	42.70	45.51	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.56	299.63	291.88	275.37	254.53	234.94	221.86	218.78	226.54	243.05	263.89	283.47	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	50.82	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	-90.42	(71)
Water heating gains (Table 5)	98.75	96.72	92.51	86.78	83.05	77.82	73.36	79.07	81.10	87.03	93.73	96.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	535.63	531.73	512.41	482.40	451.72	424.08	407.77	415.35	432.48	462.69	496.34	521.76	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	9.82	x	19.64	x 0.9 x	0.50	x	0.90	=	60.15	(76)
South	0.77	x	12.67	x	46.75	x 0.9 x	0.50	x	0.90	=	184.72	(78)

Solar gains in watts ∑(74)m...(82)m

244.87	420.19	579.14	718.15	800.20	791.32	764.30	704.39	627.92	465.92	293.96	209.08	(83)

Total gains - internal and solar (73)m + (83)m

780.50	951.92	1091.55	1200.55	1251.93	1215.40	1172.07	1119.74	1060.40	928.61	790.30	730.83	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.96	0.91	0.82	0.67	0.51	0.36	0.26	0.28	0.44	0.73	0.92	0.97	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.41	20.63	20.83	20.95	20.99	21.00	21.00	21.00	21.00	20.94	20.67	20.36

(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.08	20.08	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.09	20.09

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.89	0.79	0.63	0.46	0.31	0.20	0.23	0.39	0.68	0.90	0.97

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.34	19.64	19.89	20.05	20.09	20.11	20.11	20.11	20.10	20.04	19.71	19.27

(90)

Living area fraction — Living area ÷ (4) = 0.37 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

19.74	20.01	20.24	20.38	20.43	20.44	20.44	20.44	20.44	20.37	20.07	19.68

(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

19.74	20.01	20.24	20.38	20.43	20.44	20.44	20.44	20.44	20.37	20.07	19.68

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.95	0.89	0.79	0.64	0.48	0.33	0.22	0.25	0.41	0.69	0.90	0.96	(94)
Useful gains, ηmGm, W (94)m x (84)m	742.77	850.17	866.60	770.22	599.87	398.95	262.61	275.61	434.06	643.06	712.18	703.37	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1093.00	1067.07	967.71	798.09	604.80	399.38	262.65	275.67	435.60	677.39	903.55	1084.40	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	260.57	145.76	75.22	20.07	3.66	0.00	0.00	0.00	0.00	25.55	137.79	283.48	

∑(98)1...5, 10...12 = 952.10 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.80	(303a)
Fraction of community heat from CHP		0.20	(303b)
Fraction of total space heat from community CHP	(302) x (303a) =	0.20	(304a)
Fraction of total space heat from community boilers	(302) x (303b) =	0.80	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	952.10		(98)
Space heat from CHP	(98) x (304a) x (305) x (306) =	199.94	(307a)
Space heat from boilers	(98) x (304b) x (305) x (306) =	799.77	(307b)

Water heating

Annual water heating requirement	1762.59		(64)
Water heat from CHP	(64) x (303a) x (305a) x (306) =	370.14	(310a)
Water heat from boilers	(64) x (303b) x (305a) x (306) =	1480.57	(310b)

Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	28.50	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	115.74		(330a)
Total electricity for the above, kWh/year		115.74	(331)
Electricity for lighting (Appendix L)		312.83	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-233.18	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3045.82	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from CHP	199.94	x	2.97	x 0.01 =	5.94	(340a)
Space heating from boilers	799.77	x	4.24	x 0.01 =	33.91	(340b)
Water heating from CHP	370.14	x	2.97	x 0.01 =	10.99	(342a)
Water heating from boilers	1480.57	x	4.24	x 0.01 =	62.78	(342b)
Pumps and fans	115.74	x	13.19	x 0.01 =	15.27	(349)
Electricity for lighting	312.83	x	13.19	x 0.01 =	41.26	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-233.18	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		290.15	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.05	(357)
SAP value	85.29	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	369.9601	x	0.2160	=	79.9114	(363)
less credit emissions for electricity		-122.6636	x	0.5190	=	-63.6624	(364)
Water heated by CHP		684.8912	x	0.2160	=	147.9365	(365)
less credit emissions for electricity		-227.0818	x	0.5190	=	-117.8555	(366)
Emissions from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
CO2 emissions from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2341.21	x	0.216	=	505.70	(368)
Electrical energy for community heat distribution		28.50	x	0.519	=	14.79	(372)
Total CO2 associated with community systems						566.83	(373)
Total CO2 associated with space and water heating						566.83	(376)
Pumps and fans		115.74	x	0.519	=	60.07	(378)
Electricity for lighting		312.83	x	0.519	=	162.36	(379)

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Energy saving/generation technologies							
pv savings	-233.18	x	0.519	=	-121.02	(380)
Total CO_2, kg/year				(376)..(382) =	668.23	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	9.47	(384)
EI value					92.25	
EI rating (section 14)					92	(385)
EI band					A	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary Energy from community CHP (space and water heating)							
Power efficiency of CHP unit		33.16					(361)
Heat efficiency of CHP unit		54.04					(362)
Space heating from CHP	(307a) × 100 ÷ (362) =	369.96	x	1.22	=	451.35	(363)
less credit energy for electricity		-122.66	x	3.07	=	-376.58	(364)
Water heated by CHP		684.89	x	1.22	=	835.57	(365)
less credit energy for electricity		-227.08	x	3.07	=	-697.14	(366)
Primary energy from other sources (space heating)							
Efficiency of boilers		97.40					(367b)
Primary energy from boilers	[(307b)+(310b)] x 100 ÷ (367b) =	2341.21	x	1.22	=	2856.28	(368)
Electrical energy for community heat distribution		28.50	x	3.07	=	87.51	(372)
Total primary energy associated with community systems						3156.99	(373)
Total primary energy associated with space and water heating						3156.99	(376)
Pumps and fans		115.74	x	3.07	=	355.32	(378)
Electricity for lighting		312.83	x	3.07	=	960.38	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-233.18	x	3.07	=	-715.85	(380)
Primary energy kWh/year						3756.84	(383)
Dwelling primary energy rate kWh/m2/year						53.21	(384)

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APPENDIX 3

Retail Unit BRUKL document

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Retail

As designed

Date: Wed Jun 13 11:16:41 2018

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.3"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.3

BRUKL compliance check version: v5.4.b.0

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scott Hedges

Telephone number: 01932753739

Address: 51 Staines Road West, Sunbury-on-Thames, TW16 7AH

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	39
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	39
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	37.4
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.14	0.14	External Wall
Floor	0.25	0.2	0.2	Ground Floor
Roof	0.25	0.12	0.12	Roof
Windows***, roof windows, and rooflights	2.2	1.5	1.5	Morrisons Glazing
Personnel doors	2.2	2.18	2.18	Morrisons Rear Door
Vehicle access & similar large doors	1.5	1.49	1.49	Morrisons V. Door
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	2

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- A12 Warehouse/Store

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

2- A12 Shop (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	5	-	1.6	0.7
Standard value	0.91*	2.6	N/A	1.6^	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
A12 Warehouse/Store 1	100	-	-	266
A12 Shop 1	-	100	22	2256
A12 Shop 2	-	100	22	7795
A12 Warehouse/Store 2	100	-	-	93
A12 Warehouse/Store 3	100	-	-	66
A12 Circulation 1	-	100	-	93

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
A12 Shop 1	YES (+54%)	NO
A12 Shop 2	NO (-84%)	NO
A12 Circulation 1	YES (+113%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1569	1569
External area [m²]	3099	3099
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	2	6
Average conductance [W/K]	795	871
Average U-value [W/m²K]	0.26	0.28
Alpha value* [%]	5.65	5.65

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.36	8.62
Cooling	28.81	30.87
Auxiliary	5.28	3.07
Lighting	36.3	38.49
Hot water	1.16	1.34
Equipment*	157.12	157.12
TOTAL**	**76.9**	**82.38**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	565.81	448.92
Primary energy* [kWh/m²]	220.89	229.09
Total emissions [kg/m²]	37.4	39

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Multiburner radiant heaters, [HS] Radiant heater, [HFT] Natural Gas, [CFT] Electricity										
	Actual	69.7	0	21.3	0	0	0.91	0	0.91	0
	Notional	101	0	34.3	0	0	0.82	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	2.4	737.2	0.2	41	7.5	4	5	4	5
	Notional	2.1	568.6	0.2	43.9	4.4	2.43	3.6	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.14	External Wall
Floor	0.2	0.2	Ground Floor
Roof	0.15	0.12	Roof
Windows, roof windows, and rooflights	1.5	1.5	Morrisons Glazing
Personnel doors	1.5	2.18	Morrisons Rear Door
Vehicle access & similar large doors	1.5	1.49	Morrisons V. Door
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	2