
Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

Audit sheet

Revisions:	No.:	Date:	Approved:
	1	8/11/21	AF
	2	22/11/21	AF
	3	26/11/21	JG

This report has been prepared for Hillingdon Council only and expressly for the purposes of obtaining consent. we owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

Executive Summary

This report describes the Energy Statement and Sustainability Strategy for the proposed development of 30 new Apartments at Phase 1a of the Avondale Drive Estate in the London Borough of Hillingdon. It forms the Detailed First Phase of the Hybrid Planning Application.

The proposals target a 101% reduction in Regulated CO₂ emissions compared to Building Regulations (i.e. “Zero Carbon”) entirely through on-site measures; no carbon offset component is proposed.

They achieve this through the use of:

Firstly: high levels of insulation, airtightness and mechanical ventilation with high efficiency / low SFP heat recovery mechanical ventilation

Secondly: separate, centralised heat pump systems for domestic hot water and space heating – each optimised to the operating temperatures of the system it serves.

Thirdly: an extensive rooftop PV array (1.25KWp per dwelling)

Lastly: a commitment to ongoing CO₂ monitoring (i.e. energy consumption) in use.

The CO₂ emissions reductions at each stage of the Energy Hierarchy set out under London Plan Policy SI 2 are summarised below.

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	28.0	18.4
After energy demand reduction (be lean)	22.1	18.4
After heat network connection (be clean)	7.6	18.4
After renewable energy (be green)	-0.2	18.4

Table 1 | Carbon Dioxide Emission reduction for each stage of the Energy Hierarchy

Note: the proposal is to achieve net-zero in use, entirely through on-site measure; no Carbon offset required.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

1 Introduction

This Energy Statement has been compiled in accordance with the requirements set out by the Hillingdon Council Local Plan (Part 1 2012 and Part 2 2020) alongside the London Plan (2021). The proposals have been developed within the context of national, regional, and local planning policy that seek to address the challenges of climate change and outline plans to improve the sustainability, energy use and resource consumption of London's building stock.

The energy strategy proposed is to meet the London Plan. The London Plan requires that from 2019 all residential schemes achieve a zero-carbon target in regulated carbon dioxide emissions onsite.

The report refers to the predicted carbon footprint (as defined in Approved Document Part L) and considers various options for low and zero carbon (LZC) technologies. Sustainability forms an integral part of the design and demonstrates how the scheme meets the national, regional, and local planning policy for sustainability.

This report supports a Hybrid Planning Application for the redevelopment of existing Hayes Town Centre Estate to provide Avondale Drive Estate to provide 240 new and replacement homes overall on behalf of London Borough of Hillingdon (LBH). It relates specifically to the Detailed First Phase of the Hybrid Planning Application which comprises of 30 residential units. The remainder of the estate forms the Outline Area comprising of 210 units and is subject to separate assessment to demonstrate compliance with the relevant planning policies and standards based on the outline parameters and will guide the detailed design of the future phases through the proposed energy and sustainability principles as part of a coordinated approach to achieving net zero across the estate.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

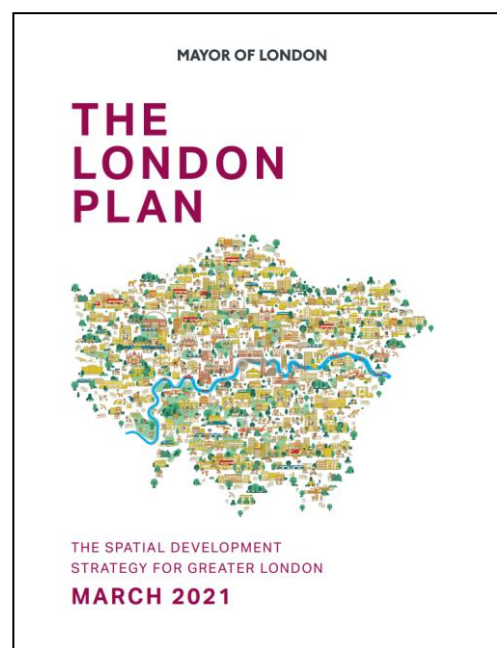
Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

2 Planning Policy

Multiple layers of energy and carbon targets apply to this scheme at national, regional, and local level, these include:

- The London Plan (March 2021), which is produced by the Mayor of London and is the overall strategic plan for London
- Hillingdon Local Plan, reducing carbon dioxide (CO₂) emissions and adapting to future climate change are key issues for the borough this includes:
 - The Local Plan: Part 1 - Strategic Policies ("LPP1") (November 2012);
 - The Local Plan: Part 2 - Development Management Policies ("LPP2") (January 2020);
 - The Local Plan: Part 2 - Site Allocations and Designations ("LPP2") (January 2020).
- Other considerations:
 - National Planning Policy Framework (NPPF) (2021)
 - National Planning Practice Guidance (PPG)



Energy and Carbon Targets

Policy SI 2 Minimising greenhouse gas emissions

- A Major development should be net zero-carbon.¹⁵¹ This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
- 1) be lean: use less energy and manage demand during operation
 - 2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
 - 3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
 - 4) be seen: monitor, verify and report on energy performance.

Figure 1: Extract from London Plan

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

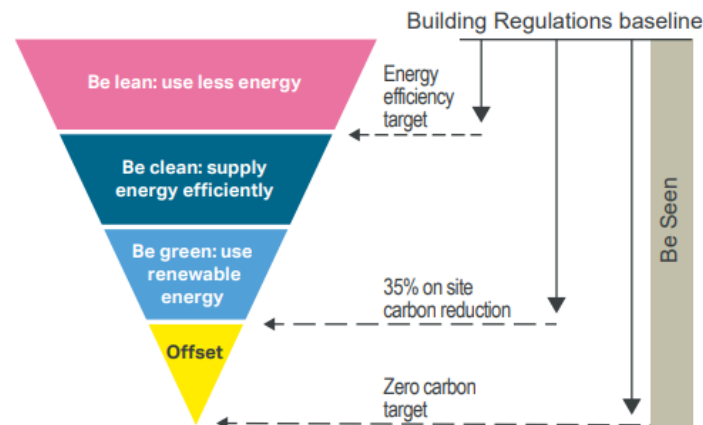


Figure 2: Energy hierarchy by importance

The local policy for Hillingdon (Hillingdon Local Plan Part 1 and Part 2) seeks to ensure that all new residential developments are built in line with the London Plan and Building Regulations to reach zero carbon by 2016.

Under London Plan 2021 Policy SI 2 'Minimising greenhouse gas emissions', the London Plan requires major developments and domestic schemes to achieve zero carbon status with a minimum on-site CO₂ emissions reduction of 35% from that required for compliance with Part L of the 2013 Building Regulations. This policy states that the development proposals should make the fullest contribution to minimising greenhouse gas emissions in accordance with the following energy hierarchy:

1. Be lean: use less energy
2. Be clean: exploit local energy resources and supply energy efficiently
3. Be green: maximise renewable energy by producing, storing and using onsite
4. Be seen: monitoring of energy demand and greenhouse gas emissions

Policy SI 3 Energy Infrastructure. This states that major development proposals within Heat Network Priority areas should have a communal low-temperature heating system following the hierarchy below:

- Connection to existing or planned heat network
- Use zero emissions of local secondary heat sources (heat pumps)
- Use low emission CHP
- Use Ultra-Low NO_x gas boilers

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

3 Baseline Energy Demand Assessment

The baseline energy demands have been predicted using a building energy model that is specific to the development. In line with the energy guidance of the London Plan for new build developments the notional dwelling and building form the be lean stage of the hierarchy.

The Target Emission Rate (TER) for the notional building is produced by applying the current notional building /dwelling specification form Part L and applying it to a building the same size and shape as the proposed development. In line with the London Plan SAP 10 carbon emission factors have been used. Taking the TER from domestic and non-domestic calculation gives a baseline CO2 emission of 28.0 tonnes.

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	28.0	18.4

Table 2 | Carbon Dioxide Emission for Baseline Energy Demand

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

4 Be Lean – Demand Reduction - Energy Efficiency

Where possible passive design measures have been utilised in the design, including: -

- Improvements to the building U-Values for all building elements when compared when the limiting values of Part L of the Building Regulations.
- Improved airtightness compared to part L.
- Most fabric parameters are better than the notional specification. There is a budgetary trade-off between increasing wall versus window performance.
- Residential window area to wall percentage is approximately 35%.

Active design measures have been applied to the scheme include: -

- Energy efficient lighting throughout
- Energy efficiency mechanical ventilation systems with heat recovery above the notional specification.

	Part L1A (2013) Minimum Performance	Part L1A (2013) Notional Performance	Proposed Building Performance
Construction Element	U Value W/m ² K		U Value W/m ² K
Ground Floor	0.25	0.13	0.11
External Wall	0.30	0.18	0.15
Roof	0.20	0.13	0.11
Windows	2.0	1.4	1.2
	Infiltration (m ³ /hr.m ² at 50Pa)		Infiltration (m ³ /hr.m ² at 50Pa)
Air Tightness	10	5	3.0

Table 3 | Comparison of domestic development fabric specification versus the Building Regulations

The target fabric energy efficiency has been bettered by the dwelling fabric energy efficiency for the residential part of the development.

	Target Fabric Energy Efficiency (kWh/m ²)	Dwelling Fabric Energy Efficiency (kWh/m ²)	Improvement (%)
Development total	32.37	27.82	14%

Table 4: Domestic fabric energy efficiency comparison

In line with the requirements of the London Plan, the 'be lean' case assumes that the heating is provided by gas boilers. This is so that the Be Lean stage is a demonstration of demand reduction alone. After the Be Lean stage there is a reduction in carbon dioxide emissions of 21% - which has comfortably exceeded the requirement for a 10 percent reduction in carbon dioxide emissions through passive and active measures alone.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	5.9	21%

Table 5: Be Lean Carbon Dioxide Savings

The “Be lean” measures include Mechanical Ventilation with Heat Recovery fitted as standard to every Apartment. An indicative layout is shown below.

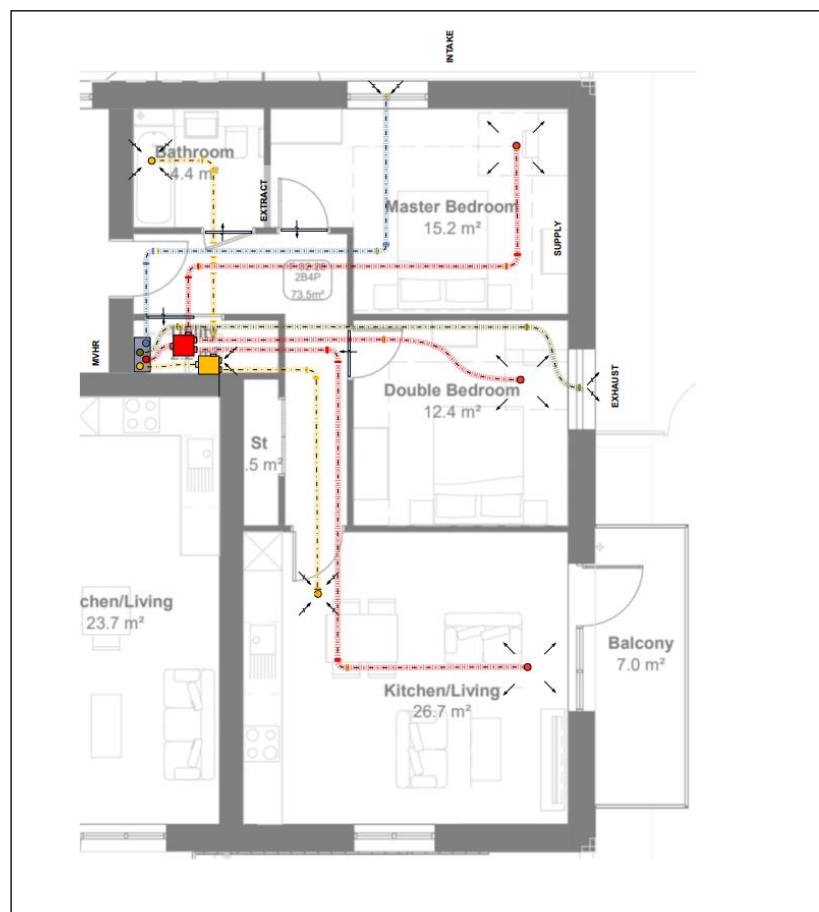


Figure 3: MVHR layout for a typical flat

The use of MVHR does not rule out opening windows for additional ventilation, but it permits windows in those apartments that may experience poor air quality or high levels of noise due to the proximity to Abbottswood Way, to remain closed.

Furthermore, NOx filters and High Efficiency Particulate Air filters will be fitted to the MVHR systems in those apartments. (Refer to separate air quality report).

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

6 Be Clean – Heating infrastructure



Figure 4: Heat Map for Avondale Drive Estate

As can be seen from the London Heat Map, the proposed development is around 900m from a proposed district heating network, but it is understood that this is unlikely to be available in the near future. LBH LPP2 Policy DMEI 3 asks that a major development needs to confirm no DEN within 500m or required to come forward within 3 years but nonetheless the proposed strategy seeks to future proof the development so is considered to be policy compliant.

As the proposed heating strategy (see next section) is based on central plant (central, roof-mounted heat pumps) rather than individual heating systems for each apartment, it would be very straightforward to swap the heat generating equipment for a District Heating Substation at any point in the future, should a DHN ever be installed nearby and should it be demonstrated to be feasible and viable at that point in time. To that end, the scheme allows for 2 No. 100mm diameter ducts into the plantroom – to minimise future groundworks/trenching – and sufficient space for a 75KW DHN substation in the plantroom itself.

CHP is not proposed for this development and is no longer endorsed by the GLA. In line with the requirements of the London Plan, where heat pumps are used as part of a building heating network then the carbon savings attributed to their use should be included under the Be Clean stage of the energy hierarchy.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

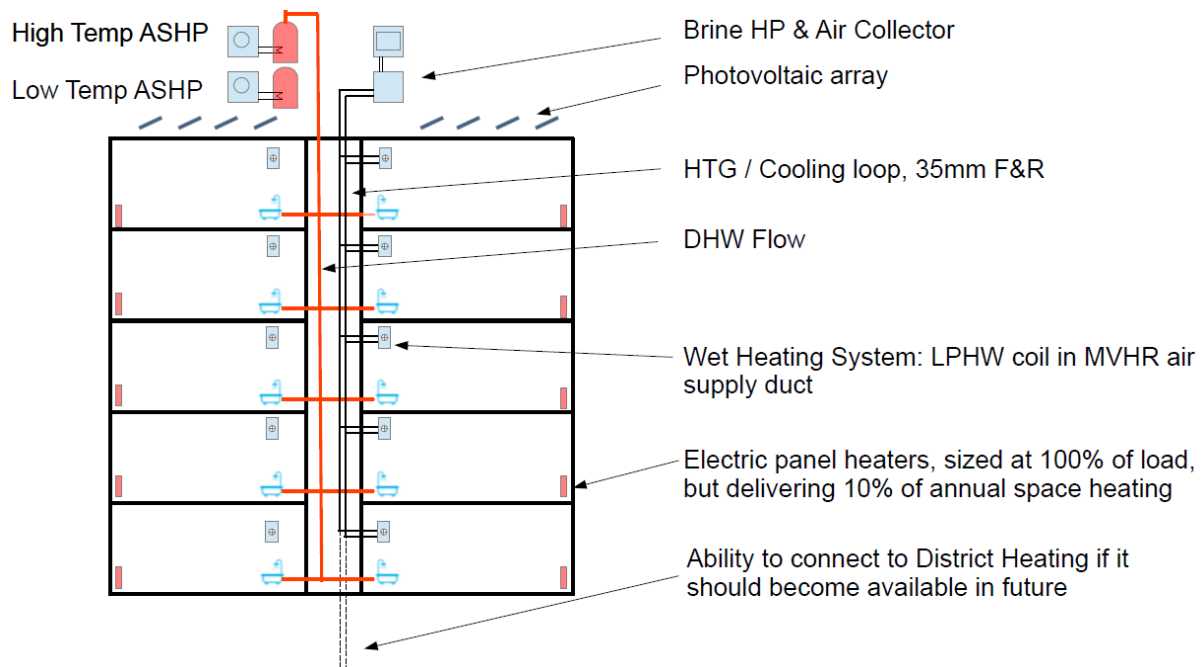


Diagram 1: Integration of low and high temperature heat pumps to building heating network

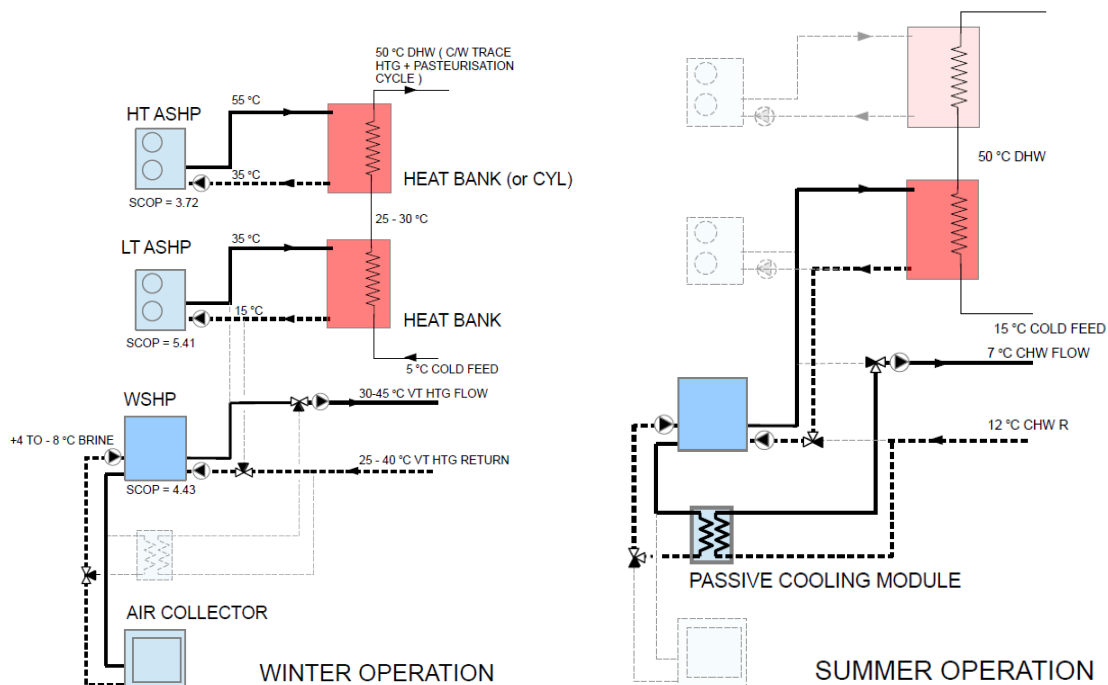


Diagram 2 & 3: Winter and Summer Operation of Heat Pumps

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

The proposal for the space heating is to use a Water to Water Heat Pump connected to a brine loop and an air collector. In wintertime this system shall function like a normal air source heat pump. Very Low Temperature Hot Water will be heated central and circulated to the apartments where it will be used to heat the spaces using a air heating coil connected to the MVHR, similar in style to the air heating used in PassivHaus. This system shall deal with 90 percent of the annual space heating energy requirement with small localised electric panel heaters for the final 10%. This Bivalent system has been modelled in the domestic Be Clean SAP calculations.

To put these figures into round terms, the heat energy consumption at the proposed development will be as follows:

Total Heat: 89,471KWh per annum (2,982 KWh per flat)

Domestic Hot Water: 65,069KWh (2,168KWh per flat) all of which comes from low-Carbon Air Source Heat pumps

Space Heating: 24,402 KWh (815KWh per flat) 93% of which comes from low–Carbon Air Source Heat Pumps (755KWh per flat) and 7% comes from high-Carbon direct electric heating (60kWh per flat).

Note: 60kWh represents only 3% of the apartment's total heat input – as such it can be regarded as “secondary heating”. It is also considerably less than the electricity used for fans and pumps (152kWh per flat), or for lighting (321kWh per flat), or cooking (301 kWh) or “appliances” (2327kWh).

Note: the controls for the heating in each apartment will comprise a master thermostat which controls the main heating coil in the MVHR supply duct, to supply heated air to the apartment 24/7 at a temperature based upon outside air; eg 33 degC when it is 4 deg C outside / 25 deg C when it is 10 deg C / 15 deg C when it is 15 deg outside. Each panel heater has individual time and temperature control. This enables the landlord's system to maintain a constant 24/7 baseline temperature of 19 or 20 deg C (adjustable), and the individual electric heater then provides a small boost for a short, timed, duration, for the individual room; eg lift the Bathroom to 24 deg C for an hour in the morning, or evening, or when the occupant usually showers and lift the living room to 21deg C from say 06:00 - 08:00 and 18:00 – 22:00.

The purpose of this arrangement is to make sure the maximum amount of heating comes from the landlords Heat Pump, and the bare minimum (for fine temperature adjustments) comes from the resident's electric secondary heating. To this end we also propose to place the secondary electrical heaters on a dedicated, sub-metered, circuit so the resident can see how much they are spending on electric heating (at 18p per kWh) vs. how much they are spending on communal heating (at 5p per kWh). The intention is that this will act as a psychological “nudge” to encourage less use of top-up and more use of heat from the Landlord's heat pumps.

In summer mode the brine source heat pump's brine loop is diverted to providing to the apartments to provide a degree of air tempering which will assist in reducing summer time overheating risk, especially for those units facing the roadway on Abbottswood Way where there are noise concerns and a resulting desire not to rely solely on opening windows.

The proposal for domestic hot water is to heat central buffers using a two stage heating process with a high and low temperature air source heat pumps. When air tempering is required the low temperature lift of the domestic hot water buffers will be handled by the brine source heat pump as previously described.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

This is to make use of the cooling produced while generating hot water which would ordinarily be dumped to atmosphere. In this respect the air tempering to the flats is free cooling, or waste cooling, with the controls arranged such that the system is hot water demand led not apartment tempering demand led. The specifications of the heat pumps are given in Appendix C.

After the Be Clean stage of the energy hierarchy there is a 52% percent reduction in domestic emissions when compared with the Part L baseline adapted to SAP10 carbon emission factors.

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	5.9	21%
Be clean: Savings from heat network	14.5	52%

Table 6: Domestic carbon dioxide emissions after Be Clean

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

7 Be Green – Renewable Energy Technology

In line with the London Plan 2021 requirements, a feasibility assessment of potential renewable energy technologies has been undertaken, and the results from this are presented below: -

Technology	Appraisal	Included in the Development
Air Source Heat Pumps (ASHP)	This Technology is deemed appropriate to provide both space heating and hot water to the residential dwellings – more details can be found in Section 6	YES
Biomass	This technology is not considered a practical solution to reducing greenhouse gas emissions. There is limited storage space for the combustible material alongside accessibility to site for regular deliveries of the materials which in itself has associated greenhouse gas emissions. Local air quality will also be adversely affected by the combustion of the biomass material.	NO
Ground Source Heat Pumps (GSHP)	Whilst this technology is technically feasible, this technology has been rejected on the basis that it would compete with the (more economically viable) ASHP's	NO
Photovoltaics (PV)	As detailed below, the use of PV panel is appropriate for this scheme. PV panel installation has been maximised to achieve net zero carbon in conjunction with ASHP. Full details of the proposed PV arrays, areas, locations, and outputs are set out below.	YES
Solar Thermal Hot Water	Whilst this technology is technically feasible, this technology has been rejected on the basis that hot water produced by the Solar Hot Water Panel would compete with the ASHP system. In addition, the Solar Hot Water Panels would also compete for Roof Space with the PV panels which we have considered a more appropriate use of the roof space. Therefore, this technology is therefore rejection.	NO
Wind Turbines	This technology was rejected on the basis of its potential impact on visual amenity and relatively low efficiency from unpredictable, turbulent wind conditions in urban locations	NO

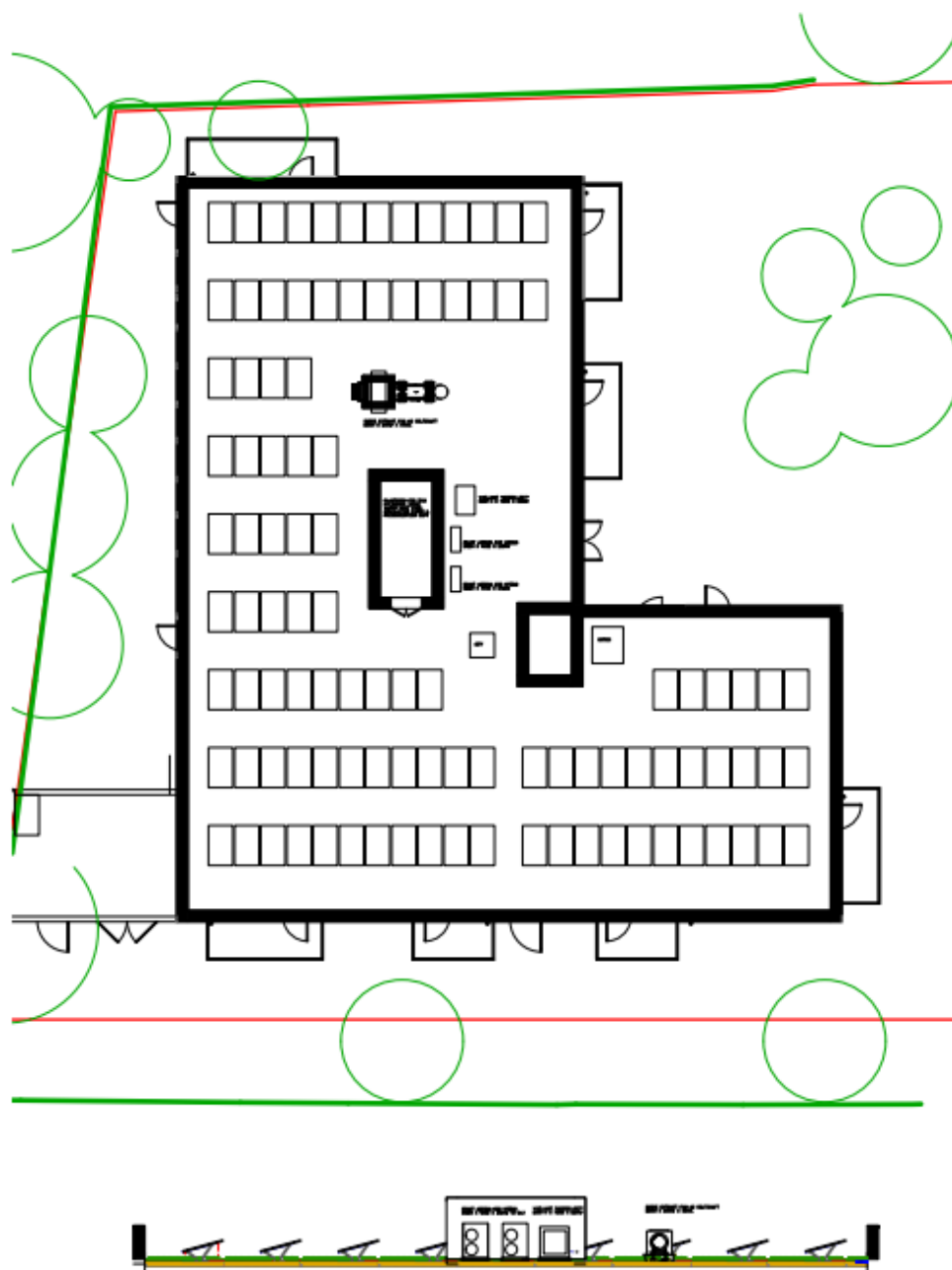
Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

Photovoltaic Panels

A total output of 39KW (1.30KW per flat) is needed to deliver net-zero Carbon. This would require 101 No. PV Panels rated at 385W each if all are located facing South with little shading.



Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

Diagram 4: Roof plan showing heat pump space allocation and 310 x 350W PV panels

The use of PV does not conflict with the heat pumps or any of the technology proposed for this scheme. In periods of hot sunny weather, energy generated by the PV can be consumed by the centralised heat pump which for some of the day would be working in hot water generating /air tempering mode after the hot water buffers have been depleted by the high period of use in the morning.



	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	5.9	21%
Be clean: Savings from heat network	14.5	52%
Be green: Savings from renewable energy	7.8	28%
Cumulative on site savings	28.2	101%

Table 7: Domestic carbon dioxide emissions after Be Green

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

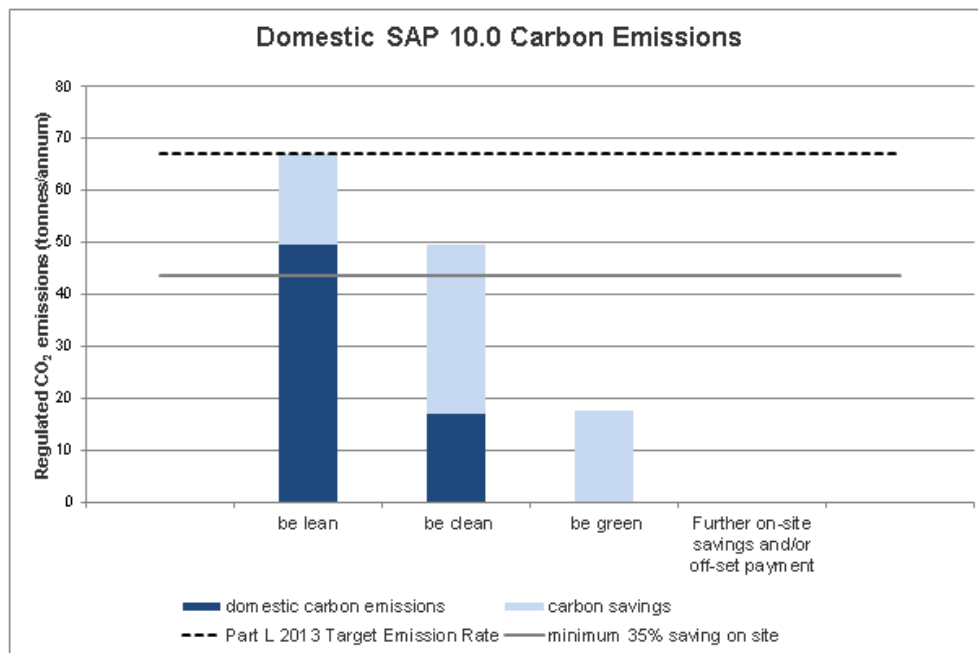


Figure 5: Carbon Dioxide emissions at each stage of the Energy Hierarchy

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

8 Be Seen – Demand Reduction - Energy Efficiency

The spreadsheet in Appendix C gives a summary of the contextual information for Energy Performance monitoring. Note: to facilitate the actual data collection, post-handover both the Electricity input and heat output of the Heat Pumps will be recorded. When this is combined with the readings from individual heat meter, domestic hot water meter and secondary electric heating circuit in each flat, it should make it easy to calculate useful data such as: actual SCOP in use vs MCS certificate figures, standing losses between central plant and flats, real world domestic hot water consumption, real world heating patterns of use.

The spreadsheet is for ease of reference; the data therein is separately uploaded to the GLA reporting website.

Note: the landlords areas are unheated, and will have less than 5% of the development energy consumption, therefore they have been excluded on a de-minimis basis.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

9 Sustainability Principles

This section of the report describes how the sustainable development principles:

9.1 Minimising Water Consumption

All water fixture and fittings will be specified to minimise water consumption. This will include the specification of low flow taps and dual flush toilets. The development will target a water consumption rate of 105l per person per day.

Grey water recycling was deemed unfeasible on this site.

9.2 Protect and Enhance Biodiversity and Facilitate Access to Nature

Please refer to The Environmental Partnership report.

9.3 Climate Change Adaption (SUDS)

The London Borough of Hillingdon is a highly urbanised borough with limited permeable surface. As a result, the area is considered to have increased flooding risk. This flooding risk is likely to be increased further by increased urbanisation of the area and the anticipated increase in heavy rain fall due to climate change.

The proposed development does not increase the hard standing of the site and as a result will not increase surface run-off rates in the area. Excess post development run-off will be discharged to the public sewer.

The run-off from the roof area will be relatively uncontaminated and will not require any additional treatment before it is discharged into the public sewer.

SUDS design has been provided by Whiby Wood, please refer to their report

9.4 Climate Change Adaption: Overheating

Energy efficient design and natural ventilation has been utilised to ensure that the risk of summertime overheating is minimised in line with the 'cooling hierarchy'.

Combinations of high fabric performance and good natural daylighting within the building will yield benefits in terms of reduced electrical lighting use and reduced space heating requirements as a result of beneficial solar gains during the winter months.

Some façade will require non-openable windows for acoustic and/or air quality and these units will be provided with tempered air.

Please refer to Synergy's Overheat Risk Assessment report.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

9.5 Sustainable Materials, Waste and Construction Impacts

The environmental impact of materials used on site will be minimised where possible by specifying locally supplied, low-impact and recycled materials. It is proposed that 100% of the timber used in the development will be from FSC or PEFC sources. The London Borough of Hillingdon requires that a minimum of 10% of the total value of materials selected are derived from recycled and reused content.

The final materials to be used will be determined at detailed design stage. The materials specified will have a low embodied impact on the environment and achieve a rating of A+ to D in BRE's Green Guide to Specification. Materials will be hard wearing and will not release toxins into the internal and external environment, including those that deplete stratospheric ozone.

The waste hierarchy will be implemented on site to minimise waste during construction. In line with the waste hierarchy the preferred approach to specifying materials will be:

- The use of reclaimed materials
- The use of materials with higher levels of recycled content
- The use of new materials

The proposed development will incorporate best practice sustainable design standards during the design, construction, and operation of the development.

The waste storage area for the proposed dwellings will be located on the ground floor. The waste storage area is easily accessible internally by the residents and provides easy access to the road for removal of waste.

9.6 Operational Sustainability

Lighting and heating controls will be designed to allow each room/space to be controlled separately. Controls specifications will be provided in full to the residents of the dwelling to ensure their optimal operation.

Smart meters will be fitted within the building to monitor energy and water consumption. This will assist the residents to eliminate excess energy and water usage and reduce running costs.

The provision for a Building User Guide for the building is encouraged. The Guide will provide the residents with the information necessary to ensure optimal use, operation, maintenance and environmental performance of the installed services. The guide should be simple and easy to read and cover the significant operational and maintenance issues that relate to the building, including how to heat and cool the building efficiently and effectively.

Sustainable transport has been allowed for as part of the plans with cycle storage space incorporated into the ground floor of the building.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

10 Summary and Conclusions

This Energy Statement and Sustainability Strategy provides an overview as to how the proposed redevelopment at Avondale Drive Estate achieves net-zero carbon and gives an overview of the design proposals that will ensure the development operates in an energy efficient manner over the lifespan of the scheme.

Section 8 of this report demonstrated that the proposals support relevant policy relating to energy guidelines set out in the London Plan 2021 and London Borough of Hillingdon's Local Plan (Part 1 and 2).

The energy assessment has shown that the proposed development will achieve net-carbon zero with a total reduction of 101% in carbon dioxide emissions onsite.

The measures for 'Be Lean' include:

- Improvements to the building U-Values for all building elements when compared when the limiting values of Part L of the Building Regulations.
- Improved airtightness compared to part L.
- Most fabric parameters are better than the notional specification. There is a budgetary trade-off between increasing wall versus window performance.
- Residential window area to wall percentage is approximately 35%.
- Energy efficient lighting throughout
- Energy efficiency mechanical ventilation systems with heat recovery above the notional specification.

The 'Be Clean' measures include the incorporation of ASHP to meet both Heating and Hot Water demands alongside future capped off connections to allow connection to District Heat Network in the future.

The 'Be Green' measure of rooftop PV panels incorporated into the green roof system provide zero-carbon electricity onsite.

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

Reductions achieved at each stage as set out in table below:

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	5.9	21%
Be clean: Savings from heat network	14.5	52%
Be green: Savings from renewable energy	7.8	28%
Cumulative on site savings	28.2	101%

Table 7: Domestic carbon dioxide emissions after Be Green

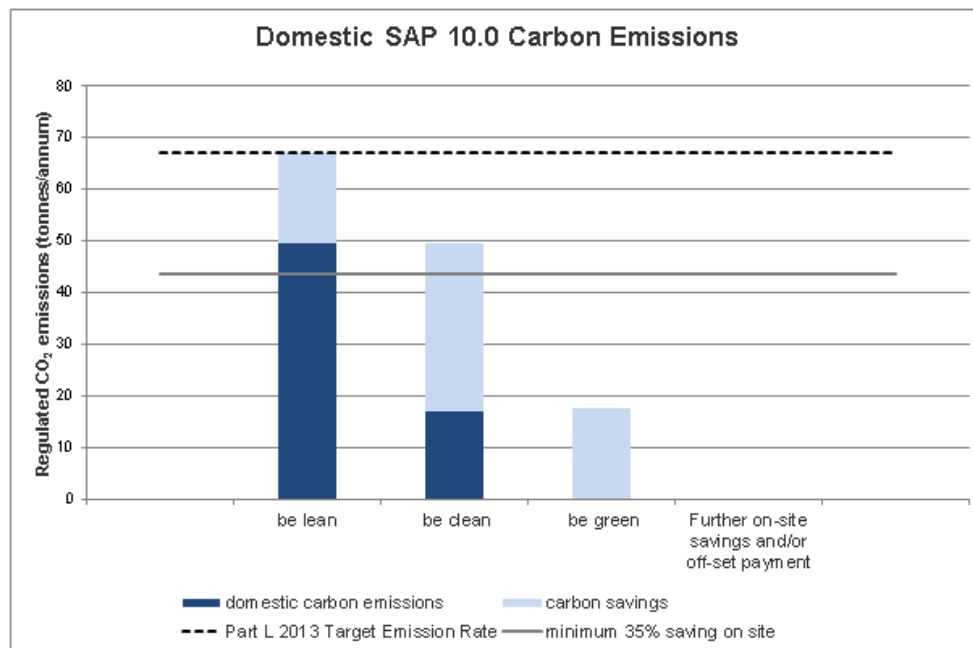


Figure 5: Carbon Dioxide emission reduction at each stage of the Energy Hierarchy

Avondale Drive Estate – Energy Statement and Sustainability Strategy

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	Avondale A.02.007			Issued on Date	26/11/2021
Assessment Reference	Avondale A02.007	Prop Type Ref	Avondale Phase 1a		
Property					
SAP Rating	87 B	DER	11.61	TER	14.28
Environmental	91 B	% DER<TER	18.69		
CO ₂ Emissions (t/year)	0.74	DFEE	25.90	TFEE	30.99
General Requirements Compliance	Pass	% DFEE<TFEE	16.42		
Assessor Details	Mr. William O'Reilly, Synergy Consulting Engineers Limited, Tel: 02075298950, william.oreilly@synconsult.co.uk			Assessor ID	H824-0001
Client					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Top-floor flat, total floor area 71 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 14.28 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.61 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)31.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)25.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.075

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
Vaillant Ecotec

Efficiency: 90%	
Minimum: 88%	OK

Secondary heating system:	None
---------------------------	------

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 1.43 kWh/day
Permitted by DBSCG 1.89	OK
Primary pipework insulated:	Yes OK

6 Controls

Space heating controls:	Time and temperature zone control	OK
-------------------------	-----------------------------------	----

Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK

Boiler interlock	Yes	OK
------------------	-----	----

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%	
Minimum	75% OK

8 Mechanical ventilation

Continuous supply and extract system	
Specific fan power:	0.42
Maximum	1.5 OK
MVHR efficiency:	91%
Minimum:	70% OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
-----------------------------------	--------	----

Based on:

Overshading:	Average
Windows facing South:	4.00 m ² , No overhang
Windows facing West:	14.75 m ² , No overhang
Air change rate:	6.00 ach
Blinds/curtains:	None

10 Key features

Party wall U-value	0.00 W/m ² K
Party wall U-value	0.00 W/m ² K
Air permeability	3.0 m ³ /m ² h

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					0 * 10 = 0.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)							
Pressure test					Yes							
Measured/design AP50					3.0000							
Infiltration rate					0.1500 (18)							
Number of sides sheltered					2 (19)							
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)							
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1275 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:	0.5000 (23a)											
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.3500 (23c)											
Effective ac	0.2758	0.2726	0.2694	0.2535	0.2503	0.2344	0.2344	0.2312	0.2408	0.2503	0.2567	0.2631 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
windows (Uw = 1.20)			18.7500	1.1450	21.4695			(27)					
External Wall 1	46.2500	18.7500	27.5000	0.1500	4.1250	70.0000	1925.0000	(29a)					
Total net area of external elements Aum(A, m2)			46.2500					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		25.5945			(33)					
Party Wall hall			13.7500	0.0000	0.0000	180.0000	2475.0000	(32)					
Party Wall flat			32.5000	0.0000	0.0000	110.0000	3575.0000	(32)					
Party Floor 1			70.6000			40.0000	2824.0000	(32d)					
Party Ceilings 1			70.6000			40.0000	2824.0000	(32b)					
Internal Wall 1			165.3000			9.0000	1487.7000	(32c)					
Heat capacity Cm = Sum(A x k)					(28) ... (30) + (32) + (32a) ... (32e) =		15110.7000	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							214.0326	(35)					
Thermal bridges (User defined value 0.075 * total exposed area)							3.4688	(36)					
Total fabric heat loss						(33) + (36) =	29.0632	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 16.0647	Feb 15.8790	Mar 15.6934	Apr 14.7651	May 14.5795	Jun 13.6512	Jul 13.6512	Aug 13.4655	Sep 14.0225	Oct 14.5795	Nov 14.9508	Dec 15.3221	(38)
Heat transfer coeff	45.1279	44.9423	44.7566	43.8283	43.6427	42.7144	42.7144	42.5287	43.0857	43.6427	44.0140	44.3853	(39)
Average = Sum(39)m / 12 =												43.7819	(39)
HLP	Jan 0.6392	Feb 0.6366	Mar 0.6339	Apr 0.6208	May 0.6182	Jun 0.6050	Jul 0.6050	Aug 0.6024	Sep 0.6103	Oct 0.6182	Nov 0.6234	Dec 0.6287	(40)
HLP (average)												0.6201	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
Daily hot water use	Jan 96.6783	Feb 93.1627	Mar 89.6471	Apr 86.1315	May 82.6160	Jun 79.1004	Jul 79.1004	Aug 82.6160	Sep 86.1315	Oct 89.6471	Nov 93.1627	Dec 96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)										Total = Sum(45)m =		1382.8412 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	21.5057	18.8090	19.4092	16.9214	16.2365	14.0109	12.9831	14.8983	15.0762	17.5699	19.1789	20.8271	(46)
Water storage loss:													
Store volume												150.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.9283	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.7736	(55)
Total storage loss													
	23.9825	21.6616	23.9825	23.2088	23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	(56)
If cylinder contains dedicated solar storage													
	23.9825	21.6616	23.9825	23.2088	23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	190.6159	168.0660	176.6395	158.5302	155.4881	139.1265	133.7990	146.5670	146.2292	164.3776	173.5804	186.0921	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	190.6159	168.0660	176.6395	158.5302	155.4881	139.1265	133.7990	146.5670	146.2292	164.3776	173.5804	186.0921	(64)
								Total per year (kWh/year) = Sum(64)m =				1939.1114	(64)
Heat gains from water heating, kWh/month													
	85.4668	75.8315	80.8196	74.0858	73.7868	67.6341	66.5751	70.8205	69.9957	76.7425	79.0900	83.9626	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241 (71)
Water heating gains (Table 5)	114.8747	112.8445	108.6285	102.8969	99.1758	93.9362	89.4827	95.1888	97.2162	103.1486	109.8472	112.8529 (72)
Total internal gains	391.1907	389.2418	376.8920	356.9910	336.8615	317.3713	304.6432	310.2681	320.4293	340.5310	363.6380	380.8944 (73)

6. Solar gains

[Jan]		Area		Solar flux		g		FF		Access		Gains	
		m2		Table 6a		Specific data		Specific data		factor		W	
				W/m2		or Table 6b		or Table 6c		Table 6d			
South		4.0000		46.7521		0.6000		0.7000		0.7700		54.4306	(83)
West		14.7500		19.6403		0.6000		0.7000		0.7700		84.3183	(80)
Solar gains	138.7489	254.0878	385.1929	524.5102	619.2598	625.7226	598.9336	528.5786	434.5480	291.8700	169.6539	116.3723	(83)
Total gains	529.9397	643.3296	762.0849	881.5012	956.1213	943.0939	903.5768	838.8467	754.9772	632.4010	533.2919	497.2668	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	93.0115	93.3958	93.7832	95.7695	96.1769	98.2670	98.2670	98.6960	97.4202	96.1769	95.3655	94.5677	
alpha	7.2008	7.2264	7.2522	7.3846	7.4118	7.5511	7.5511	7.5797	7.4947	7.4118	7.3577	7.3045	
util living area	0.9751	0.9235	0.7979	0.5959	0.4241	0.2898	0.2080	0.2332	0.3936	0.6992	0.9316	0.9821	(86)
MIT	20.6027	20.7827	20.9313	20.9915	20.9993	21.0000	21.0000	21.0000	20.9997	20.9803	20.8064	20.5675	(87)
Th 2	20.3948	20.3972	20.3995	20.4113	20.4137	20.4255	20.4255	20.4278	20.4208	20.4137	20.4090	20.4043	(88)
util rest of house	0.9698	0.9103	0.7740	0.5683	0.3975	0.2638	0.1808	0.2042	0.3606	0.6646	0.9174	0.9782	(89)
MIT 2	19.8731	20.1248	20.3202	20.4026	20.4131	20.4255	20.4255	20.4278	20.4206	20.3939	20.1710	19.8310	(90)
Living area fraction													
MIT	20.0654	20.2981	20.4812	20.5578	20.5675	20.5768	20.5768	20.5786	20.5731	20.5484	20.3384	20.0250	(91)
Temperature adjustment												0.0000	
adjusted MIT	20.0654	20.2981	20.4812	20.5578	20.5675	20.5768	20.5768	20.5786	20.5731	20.5484	20.3384	20.0250	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9664	0.9080	0.7773	0.5752	0.4045	0.2707	0.1880	0.2118	0.3693	0.6727	0.9155	0.9752	(94)
Ext temp.	512.1369	584.1297	592.3875	507.0723	386.7194	255.2867	169.8680	177.7088	278.7987	425.4250	488.2455	484.9129	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	711.4578	692.0267	625.7509	510.9399	387.0021	255.2963	169.8684	177.7099	278.8996	434.1758	582.6743	702.3979	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	148.2948	72.5068	24.8224	2.7847	0.2103	0.0000	0.0000	0.0000	0.0000	6.5106	67.9887	161.8088	(98)
Space heating per m2													
										(98) / (4) =		6.8687	(99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)																		0.0000 (201)
Fraction of space heat from main system(s)																		1.0000 (202)
Efficiency of main space heating system 1 (in %)																		91.0000 (206)
Efficiency of secondary/supplementary heating system, %																		0.0000 (208)
Space heating requirement																		532.8868 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec						
Space heating requirement	148.2948	72.5068	24.8224	2.7847	0.2103	0.0000	0.0000	0.0000	0.0000	6.5106	67.9887	161.8088	(98)					
Space heating efficiency (main heating system 1)	91.0000	91.0000	91.0000	91.0000	91.0000	0.0000	0.0000	0.0000	0.0000	91.0000	91.0000	91.0000	(210)					
Space heating fuel (main heating system)	162.9613	79.6778	27.2773	3.0601	0.2311	0.0000	0.0000	0.0000	0.0000	7.1545	74.7129	177.8119	(211)					
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)					
Water heating requirement	190.6159	168.0660	176.6395	158.5302	155.4881	139.1265	133.7990	146.5670	146.2292	164.3776	173.5804	186.0921	(64)					
Efficiency of water heater (217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(216)					
Fuel for water heating, kWh/month	212.9787	187.7833	197.3625	177.1287	173.7297	155.4486	149.4961	163.7620	163.3845	183.6622	193.9446	207.9241	(219)					
Water heating fuel used												2166.6049	(219)					
Annual totals kWh/year																		
Space heating fuel - main system													532.8868	(211)				
Space heating fuel - secondary													0.0000	(215)				
Electricity for pumps and fans:																		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)																		
mechanical ventilation fans (SFP = 0.5250)													113.0483	(230a)				
central heating pump													30.0000	(230c)				
Total electricity for the above, kWh/year													143.0483	(231)				
Electricity for lighting (calculated in Appendix L)													312.8287	(232)				
Total delivered energy for all uses													3155.3688	(238)				

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	532.8868	0.2160	115.1036	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2166.6049	0.2160	467.9867	(264)
Space and water heating			583.0902	(265)
Pumps and fans	143.0483	0.5190	74.2420	(267)
Energy for lighting	312.8287	0.5190	162.3581	(268)
Total CO2, kg/year			819.6904	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.6100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER			11.6100	ZC1
Total Floor Area		TFA	70.6000	
Assumed number of occupants		N	2.2606	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			16.6773	ZC2
CO2 emissions from cooking, equation (L16)			2.4540	ZC3
Total CO2 emissions			30.7413	ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000	ZC7
Net CO2 emissions			30.7413	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour
Pressure test					30.0000 / (5) = 0.1700 (8)
Measured/design AP50					Yes
Infiltration rate					5.0000
Number of sides sheltered					0.4200 (18)
					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3570 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4551	0.4462	0.4373	0.3927	0.3837	0.3391	0.3391	0.3302	0.3570	0.3837	0.4016	0.4194 (22b)
Effective ac	0.6036	0.5996	0.5956	0.5771	0.5736	0.5575	0.5575	0.5545	0.5637	0.5736	0.5806	0.5880 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opening Type (Uw = 1.40)			17.6700	1.3258	23.4261		(27)
External Wall 1	46.2500	17.6700	28.5800	0.1800	5.1444		(29a)
Total net area of external elements Aum(A, m ²)			46.2500				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 28.5705		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000 (36)
Total fabric heat loss						(33) + (36) =	28.5705 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	35.1554	34.9211	34.6915	33.6130	33.4112	32.4718	32.4718
Heat transfer coeff	63.7259	63.4917	63.2621	62.1835	61.9817	61.0423	61.0423
Average = Sum(39)m / 12 =							
HLP	0.9026	0.8993	0.8961	0.8808	0.8779	0.8646	0.8646
HLP (average)							
Days in month	31	28	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
Daily hot water use	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)										Total = Sum(45)m =		1382.8412 (45)
Distribution loss (46)m = 0.15 x (45)m	21.5057	18.8090	19.4092	16.9214	16.2365	14.0109	12.9831	14.8983	15.0762	17.5699	19.1789	20.8271 (46)
Water storage loss:												
Store volume												150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7527 (55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Primary loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (57)
Total heat required for water heating calculated for each month	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Solar input	189.9660	167.4790	175.9895	157.9012	154.8382	138.4975	133.1490	145.9170	145.6002	163.7277	172.9514	185.4421 (62)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h								Solar input (sum of months) =	Sum (63)m =			0.0000 (63)
	189.9660	167.4790	175.9895	157.9012	154.8382	138.4975	133.1490	145.9170	145.6002	163.7277	172.9514	185.4421 (64)
Heat gains from water heating, kWh/month								Total per year (kWh/year) =	Sum (64)m =			1931.4586 (64)
	84.9468	75.3618	80.2996	73.5826	73.2668	67.1309	66.0552	70.3005	69.4925	76.2226	78.5868	83.4426 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265 (68)
Pumps, fans	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241 (71)
Total internal gains	114.1758	112.1456	107.9296	102.1980	98.4769	93.2373	88.7838	94.4899	96.5173	102.4497	109.1483	112.1541 (72)
	390.4919	388.5429	376.1931	356.2921	336.1626	316.6724	303.9443	309.5692	319.7304	339.8321	362.9391	380.1956 (73)

6. Solar gains

[Jan]												Gains
	Area m2				Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		W
South	3.7700				46.7521	0.6300		0.7000		0.7700		53.8659 (78)
West	13.9000				19.6403	0.6300		0.7000		0.7700		83.4322 (80)

Solar gains	137.2982	251.4296	381.1602	519.0155	612.7701	619.1644	592.6565	523.0403	429.9974	288.8157	167.8797	115.1557 (83)
Total gains	527.7900	639.9726	757.3534	875.3076	948.9328	935.8368	896.6008	832.6095	749.7277	628.6478	530.8188	495.3513 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	76.9353	77.2192	77.4995	78.8437	79.1004	80.3177	80.5472	79.8444	79.1004	78.5828	78.0489	78.0489
util living area	6.1290	6.1479	6.1666	6.2562	6.2734	6.3545	6.3545	6.3698	6.3230	6.2734	6.2389	6.2033
	0.9931	0.9782	0.9284	0.7893	0.5967	0.4165	0.2995	0.3361	0.5584	0.8731	0.9813	0.9951 (86)
MIT	20.2477	20.4478	20.7012	20.9139	20.9857	20.9988	20.9999	20.9997	20.9929	20.8660	20.5158	20.2147 (87)
Th 2	20.1653	20.1681	20.1708	20.1839	20.1863	20.1977	20.1977	20.1998	20.1933	20.1863	20.1814	20.1762 (88)
util rest of house	0.9910	0.9721	0.9107	0.7517	0.5481	0.3647	0.2449	0.2777	0.4959	0.8370	0.9750	0.9936 (89)
MIT 2	19.1696	19.4591	19.8130	20.0944	20.1743	20.1969	20.1976	20.1997	20.1885	20.0470	19.5700	19.1303 (90)
Living area fraction	19.4537	19.7196	20.0470	20.3103	20.3881	20.4082	20.4090	20.4105	fLA = Living area / (4) =	20.2627	19.8191	0.2635 (91)
MIT	19.4537	19.7196	20.0470	20.3103	20.3881	20.4082	20.4090	20.4105	20.4004	20.2627	19.8191	19.4160 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4537	19.7196	20.0470	20.3103	20.3881	20.4082	20.4090	20.4105	20.4004	20.2627	19.8191	19.4160 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9887	0.9681	0.9077	0.7578	0.5603	0.3784	0.2593	0.2931	0.5122	0.8408	0.9715	0.9918 (94)
Ext temp.	521.8087	619.5303	687.4325	663.3378	531.7283	354.0830	232.4770	244.0410	383.9952	528.5378	515.6929	491.2702 (95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Month fracti	965.6812	940.9194	857.0136	709.5317	538.5008	354.5449	232.5095	244.1106	386.8728	598.9127	793.5469	955.8170 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating per m2	330.2412	215.9735	126.1684	33.2596	5.0387	0.0000	0.0000	0.0000	0.0000	52.3589	200.0549	345.6228 (98)
												1308.7179 (98)
										(98) / (4) =		18.5371 (99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1399.6983 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	330.2412	215.9735	126.1684	33.2596	5.0387	0.0000	0.0000	0.0000	0.0000	52.3589	200.0549	345.6228	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	353.1991	230.9877	134.9394	35.5718	5.3890	0.0000	0.0000	0.0000	0.0000	55.9988	213.9625	369.6501	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	189.9660	167.4790	175.9895	157.9012	154.8382	138.4975	133.1490	145.9170	145.6002	163.7277	172.9514	185.4421	(64)
Efficiency of water heater	86.2756	85.4932	83.9442	81.4760	80.0985	79.8000	79.8000	79.8000	79.8000	82.1536	85.2028	79.8000	(216)
(217)m	86.2756	85.4932	83.9442	81.4760	80.0985	79.8000	79.8000	79.8000	79.8000	82.1536	85.2028	86.4522	(217)
Fuel for water heating, kWh/month	220.1851	195.8974	209.6505	193.8008	193.3098	173.5558	166.8534	182.8534	182.4563	199.2947	202.9878	214.5025	(219)
Water heating fuel used												2335.3475	(219)
Annual totals kWh/year													
Space heating fuel - main system												1399.6983	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												312.8287	(232)
Total delivered energy for all uses												4122.8745	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1399.6983	0.2160	302.3348 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2335.3475	0.2160	504.4351 (264)
Space and water heating			806.7699 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	312.8287	0.5190	162.3581 (268)
Total CO2, kg/m2/year			1008.0530 (272)
Emissions per m2 for space and water heating			11.4273 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2997 (272b)
Emissions per m2 for pumps and fans			0.5513 (272c)
Target Carbon Dioxide Emission Rate (TER) = (11.4273 * 1.00) + 2.2997 + 0.5513, rounded to 2 d.p.			14.2800 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1700 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.3200 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2720 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.3468	0.3400	0.3332	0.2992	0.2924	0.2584	0.2584	0.2516	0.2720	0.2924	0.3060	0.3196 (22b)
	0.5601	0.5578	0.5555	0.5448	0.5427	0.5334	0.5334	0.5316	0.5370	0.5427	0.5468	0.5511 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
windows (Uw = 1.20)			18.7500	1.1450	21.4695			(27)
External Wall 1	46.2500	18.7500	27.5000	0.1500	4.1250	70.0000	1925.0000	(29a)
Total net area of external elements Aum(A, m2)			46.2500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...	(30) + (32) =	25.5945			(33)
Party Wall hall			13.7500	0.0000	0.0000	180.0000	2475.0000	(32)
Party Wall flat			32.5000	0.0000	0.0000	110.0000	3575.0000	(32)
Party Floor 1			70.6000			40.0000	2824.0000	(32d)
Party Ceilings 1			70.6000			30.0000	2118.0000	(32b)
Internal Wall 1			165.3000			9.0000	1487.7000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...	(30) + (32) + (32a)...	(32e) =	14404.7000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								204.0326 (35)
Thermal bridges (User defined value 0.075 * total exposed area)								3.4688 (36)
Total fabric heat loss						(33) + (36) =		29.0632 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	32.6244	32.4885	32.3552	31.7291	31.6120	31.0667	31.0667	30.9657	31.2767	31.6120	31.8489	32.0967 (38)
Heat transfer coeff	61.6877	61.5517	61.4184	60.7923	60.6752	60.1299	60.1299	60.0289	60.3399	60.6752	60.9121	61.1599 (39)
Average = Sum(39)m / 12 =												60.7918 (39)
HLP	0.8738	0.8718	0.8699	0.8611	0.8594	0.8517	0.8517	0.8503	0.8547	0.8594	0.8628	0.8663 (40)
HLP (average)												0.8611 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
Daily hot water use	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)										Total = Sum(45)m =		1382.8412 (45)
Distribution loss (46)m = 0.15 x (45)m												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	30.4663	26.6461	27.4964	23.9720	23.0017	19.8487	18.3927	21.1059	21.3580	24.8907	27.1702	29.5050 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	(71)
Water heating gains (Table 5)	40.9494	39.6519	36.9575	33.2944	30.9163	27.5677	24.7214	28.3682	29.6639	33.4553	37.7363	39.6573	(72)
Total internal gains	314.2654	313.0492	302.2210	284.3885	265.6020	248.0027	236.8820	240.4475	249.8770	267.8377	288.5271	304.6988	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
South				4.0000	46.7521		0.6000		0.7000		0.7700		54.4306 (78)
West				14.7500	19.6403		0.6000		0.7000		0.7700		84.3183 (80)
Solar gains	138.7489	254.0878	385.1929	524.5102	619.2598	625.7226	598.9336	528.5786	434.5480	291.8700	169.6539	116.3723	(83)
Total gains	453.0144	567.1370	687.4139	808.8987	884.8618	873.7253	835.8156	769.0260	684.4249	559.7077	458.1810	421.0711	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th _l (C)													21.0000 (85)
Utilisation factor for gains for living area, nil _l m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	64.8639	65.0073	65.1483	65.8193	65.9463	66.5444	66.5444	66.6563	66.3127	65.9463	65.6898	65.4237	
alpha	5.3243	5.3338	5.3432	5.3880	5.3964	5.4363	5.4363	5.4438	5.4208	5.3964	5.3793	5.3616	
util living area	0.9929	0.9776	0.9291	0.8008	0.6161	0.4376	0.3161	0.3582	0.5915	0.8895	0.9828	0.9950	(86)
MIT	20.0401	20.2776	20.5830	20.8543	20.9683	20.9958	20.9994	20.9989	20.9809	20.7791	20.3428	19.9919	(87)
Th 2	20.1899	20.1915	20.1931	20.2007	20.2021	20.2088	20.2088	20.2100	20.2062	20.2021	20.1993	20.1963	(88)
util rest of house	0.9911	0.9722	0.9139	0.7673	0.5693	0.3847	0.2595	0.2971	0.5295	0.8601	0.9778	0.9938	(89)
MIT 2	19.3113	19.5465	19.8409	20.0908	20.1821	20.2068	20.2086	20.2096	20.1962	20.0342	19.6191	19.2687	(90)
Living area fraction	19.5033	19.7391	20.0364	20.2919	20.3892	20.4147	20.4169	20.4176	20.4029	20.2304	19.8098	19.4592	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5033	19.7391	20.0364	20.2919	20.3892	20.4147	20.4169	20.4176	20.4029	20.2304	19.8098	19.4592	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	448.1012	549.3423	625.9078	623.9690	513.6952	348.1886	229.3636	240.8690	373.1615	482.0396	446.6461	417.8102	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	937.8561	913.3724	831.3829	692.5415	527.2196	349.6358	229.5115	241.1693	380.3173	584.3279	774.1810	933.2535	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	364.3776	244.6282	152.8735	49.3722	10.0621	0.0000	0.0000	0.0000	0.0000	76.1025	235.8251	383.4898	(98)
Space heating												1516.7311	(98)
Space heating per m ²										(98) / (4) =		21.4834	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	565.2210	444.9612	456.2198	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9871	0.9948	0.9917	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	557.9125	442.6399	452.4389	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1105.1954	1059.1833	982.4709	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	394.0437	458.7083	394.3438	0.0000	0.0000	0.0000	0.0000	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												1247.0958 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)	
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	98.5109	114.6771	98.5860	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												311.7739 (107)
Space cooling per m2												4.4161 (108)
Energy for space heating												21.4834 (99)
Energy for space cooling												4.4161 (108)
Total												25.8995 (109)
Dwelling Fabric Energy Efficiency (DFEE)												25.9 (109)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)
								Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						30.0000 / (5) =	0.1700	(8)
Pressure test							Yes		
Measured/design AP50								5.0000	
Infiltration rate								0.4200	(18)
Number of sides sheltered								2	(19)
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.3570	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
	0.4551	0.4462	0.4373	0.3927	0.3837	0.3391	0.3391	0.3302	0.3570	0.3837	0.4016	0.4194 (22b)
Effective ac	0.6036	0.5996	0.5956	0.5771	0.5736	0.5575	0.5575	0.5545	0.5637	0.5736	0.5806	0.5880 (25)

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opening Type (Uw = 1.40)			17.6700	1.3258	23.4261			(27)					
External Wall 1	46.2500	17.6700	28.5800	0.1800	5.1444			(29a)					
Total net area of external elements Aum(A, m2)			46.2500					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	28.5705			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								0.0000 (36)					
Total fabric heat loss						(33) + (36) =	28.5705	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.1554	34.9211	34.6915	33.6130	33.4112	32.4718	32.4718	32.2978	32.8336	33.4112	33.8194	34.2462	(38)
Heat transfer coeff	63.7259	63.4917	63.2621	62.1835	61.9817	61.0423	61.0423	60.8684	61.4042	61.9817	62.3899	62.8167	(39)
Average = Sum(39)m / 12 =												62.1825	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9026	0.8993	0.8961	0.8808	0.8779	0.8646	0.8646	0.8622	0.8697	0.8779	0.8837	0.8898	(40)
HLP (average)												0.8808	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy content (annual)	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Distribution loss (46)m = 0.15 x (45)m	Total = Sum(45)m =											1382.8412 (45)
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.4663	26.6461	27.4964	23.9720	23.0017	19.8487	18.3927	21.1059	21.3580	24.8907	27.1702	29.5050 (65)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	(71)
Water heating gains (Table 5)	40.9494	39.6519	36.9575	33.2944	30.9163	27.5677	24.7214	28.3682	29.6639	33.4553	37.7363	39.6573	(72)
Total internal gains	314.2654	313.0492	302.2210	284.3885	265.6020	248.0027	236.8820	240.4475	249.8770	267.8377	288.5271	304.6988	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c	Access factor Table 6d		Gains W	
South					3.7700	46.7521	0.6300		0.7000	0.7700		53.8659	
West					13.9000	19.6403	0.6300		0.7000	0.7700		83.4322 (80)	
Solar gains	137.2982	251.4296	381.1602	519.0155	612.7701	619.1644	592.6565	523.0403	429.9974	288.8157	167.8797	115.1557	(83)
Total gains	451.5636	564.4789	683.3812	803.4040	878.3722	867.1671	829.5385	763.4878	679.8743	556.6534	456.4068	419.8545	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, nil,m (see Table 9a)													21.0000 (85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	76.9353	77.2192	77.4995	78.8437	79.1004	80.3177	80.3177	80.5472	79.8444	79.1004	78.5828	78.0489	
alpha	6.1290	6.1479	6.1666	6.2562	6.2734	6.3545	6.3545	6.3698	6.3230	6.2734	6.2389	6.2033	
util living area	0.9970	0.9882	0.9528	0.8324	0.6394	0.4489	0.3236	0.3663	0.6110	0.9171	0.9913	0.9980	(86)
MIT	20.1447	20.3527	20.6287	20.8829	20.9793	20.9981	20.9998	20.9996	20.9884	20.8123	20.4201	20.1114	(87)
Th 2	20.1653	20.1681	20.1708	20.1839	20.1863	20.1977	20.1977	20.1998	20.1933	20.1863	20.1814	20.1762	(88)
util rest of house	0.9960	0.9846	0.9397	0.7976	0.5890	0.3934	0.2647	0.3028	0.5446	0.8890	0.9881	0.9974	(89)
MIT 2	19.3834	19.5916	19.8603	20.0987	20.1742	20.1969	20.1976	20.1997	20.1878	20.0473	19.6708	19.3595	(90)
Living area fraction	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(91)
MIT	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	449.3762	554.6914	640.8741	645.2126	528.4413	353.8185	232.4564	243.9910	381.9811	496.2157	450.2624	418.4905	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	973.9856	945.5245	858.0078	709.2221	538.3909	354.5323	232.5081	244.1073	386.7685	598.0518	796.6090	964.7165	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	390.3094	262.6399	161.5475	46.0869	7.4025	0.0000	0.0000	0.0000	0.0000	75.7661	249.3695	406.3922	(98)
Space heating												1599.5139	(98)
Space heating per m ²												22.6560	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	573.7979	451.7133	462.5996	0.0000	0.0000	0.0000	0.0000	(100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9922	0.9973	0.9955	0.0000	0.0000	0.0000	0.0000	(101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	569.3171	450.5128	460.4977	0.0000	0.0000	0.0000	0.0000	(102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1097.5299	1051.8464	975.9976	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling						380.3132	447.3922	383.5319	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction												1211.2374	(105)
Intermittency factor (Table 10b)												1.0000	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling per m ²	0.0000	0.0000	0.0000	0.0000	0.0000	95.0783	111.8481	95.8830	0.0000	0.0000	0.0000	0.0000	(107)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling	302.8093 (107)
Space cooling per m2	4.2891 (108)
Energy for space heating	22.6560 (99)
Energy for space cooling	4.2891 (108)
Total	26.9451 (109)
Target Fabric Energy Efficiency (TFEE)	31.0 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	Avondale A.02.007			Issued on Date	05/11/2021
Assessment Reference	Avondale A02.007	Prop Type Ref	Avondale Phase 1a		
Property					
SAP Rating	87 B	DER	7.44	TER	19.72
Environmental	94 A	% DER<TER	62.28		
CO ₂ Emissions (t/year)	0.46	DFEE	25.90	TFEE	30.99
General Requirements Compliance	Pass	% DFEE<TFEE	16.42		
Assessor Details	Mr. William O'Reilly, Synergy Consulting Engineers Limited, Tel: 02075298950, william.oreilly@synconsult.co.uk			Assessor ID	H824-0001
Client					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Top-floor flat, total floor area 71 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating:Electricity (c)

Fuel factor:1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 19.72 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 7.44 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)31.0 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)25.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.075

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 0.25 kWh/day	
Permitted by DBSCG 0.59	OK	
Primary pipework insulated:	Yes (assumed)	OK

6 Controls

Space heating controls: Flat rate charging, programmer and at least two room thermostatsOK

Hot water controls: Cylinderstat OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%	
Minimum	75% OK

8 Mechanical ventilation

Continuous supply and extract system	
Specific fan power:	0.42
Maximum	1.5 OK
MVHR efficiency:	91%
Minimum:	70% OK

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading:	Average
Windows facing South:	4.00 m ² , No overhang
Windows facing West:	14.75 m ² , No overhang
Air change rate:	6.00 ach
Blinds/curtains:	None

10 Key features

Party wall U-value	0.00 W/m ² K
Party wall U-value	0.00 W/m ² K
Air permeability	3.0 m ³ /m ² h

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					0 * 10 = 0.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)							
Pressure test					Yes							
Measured/design AP50					3.0000							
Infiltration rate					0.1500 (18)							
Number of sides sheltered					2 (19)							
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)							
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1275 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:	0.5000 (23a)											
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.3500 (23c)											
Effective ac	0.2758	0.2726	0.2694	0.2535	0.2503	0.2344	0.2344	0.2312	0.2408	0.2503	0.2567	0.2631 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
windows (Uw = 1.20)			18.7500	1.1450	21.4695			(27)					
External Wall 1	46.2500	18.7500	27.5000	0.1500	4.1250	70.0000	1925.0000	(29a)					
Total net area of external elements Aum(A, m2)			46.2500					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		25.5945			(33)					
Party Wall hall			13.7500	0.0000	0.0000	180.0000	2475.0000	(32)					
Party Wall flat			32.5000	0.0000	0.0000	110.0000	3575.0000	(32)					
Party Floor 1			70.6000			40.0000	2824.0000	(32d)					
Party Ceilings 1			70.6000			40.0000	2824.0000	(32b)					
Internal Wall 1			165.3000			9.0000	1487.7000	(32c)					
Heat capacity Cm = Sum(A x k)					(28) ... (30) + (32) + (32a) ... (32e) =		15110.7000	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							214.0326	(35)					
Thermal bridges (User defined value 0.075 * total exposed area)							3.4688	(36)					
Total fabric heat loss						(33) + (36) =	29.0632	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 16.0647	Feb 15.8790	Mar 15.6934	Apr 14.7651	May 14.5795	Jun 13.6512	Jul 13.6512	Aug 13.4655	Sep 14.0225	Oct 14.5795	Nov 14.9508	Dec 15.3221	(38)
Heat transfer coeff	45.1279	44.9423	44.7566	43.8283	43.6427	42.7144	42.7144	42.5287	43.0857	43.6427	44.0140	44.3853	(39)
Average = Sum(39)m / 12 =												43.7819	(39)
HLP	Jan 0.6392	Feb 0.6366	Mar 0.6339	Apr 0.6208	May 0.6182	Jun 0.6050	Jul 0.6050	Aug 0.6024	Sep 0.6103	Oct 0.6182	Nov 0.6234	Dec 0.6287	(40)
HLP (average)												0.6201	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
Daily hot water use	Jan 96.6783	Feb 93.1627	Mar 89.6471	Apr 86.1315	May 82.6160	Jun 79.1004	Jul 79.1004	Aug 82.6160	Sep 86.1315	Oct 89.6471	Nov 93.1627	Dec 96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)										Total = Sum(45)m =		1382.8412 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	21.5057	18.8090	19.4092	16.9214	16.2365	14.0109	12.9831	14.8983	15.0762	17.5699	19.1789	20.8271 (46)
Water storage loss:												
Store volume												15.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												0.2500 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.1500 (55)
Total storage loss												
4.6500 4.2000 4.6500 4.5000 4.6500 4.5000 4.6500 4.6500 4.5000 4.6500 4.5000 4.6500 (56)												
If cylinder contains dedicated solar storage												
4.6500 4.2000 4.6500 4.5000 4.6500 4.5000 4.6500 4.6500 4.5000 4.6500 4.5000 4.6500 (57)												
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)												
Total heat required for water heating calculated for each month												
171.2835 150.6044 157.3070 139.8213 136.1556 120.4177 114.4665 127.2345 127.5203 145.0452 154.8716 166.7596 (62)												
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)												
Solar input (sum of months) = Sum(63)m =												
Output from w/h												
171.2835 150.6044 157.3070 139.8213 136.1556 120.4177 114.4665 127.2345 127.5203 145.0452 154.8716 166.7596 (64)												
Total per year (kWh/year) = Sum(64)m =												1711.4872 (64)
Heat gains from water heating, kWh/month												
70.0008 61.8622 65.3536 59.1187 58.3208 52.6670 51.1092 55.3545 55.0286 61.2766 64.1229 68.4966 (65)												

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
17.7137 15.7331 12.7950 9.6867 7.2409 6.1131 6.6054 8.5859 11.5240 14.6324 17.0781 18.2060 (67)													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
198.6934 200.7552 195.5595 184.4984 170.5358 157.4130 148.6461 146.5843 151.7800 162.8410 176.8036 189.9265 (68)													
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 (69)													
Pumps, fans 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (70)													
Losses e.g. evaporation (negative values) (Table 5)													
-90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 (71)													
Water heating gains (Table 5)													
94.0871 92.0569 87.8409 82.1093 78.3882 73.1486 68.6951 74.4012 76.4286 82.3610 89.0596 92.0653 (72)													
Total internal gains													
367.4031 365.4542 353.1044 333.2034 313.0739 293.5837 280.8556 286.4805 296.6417 316.7434 339.8504 357.1068 (73)													

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
South					4.0000	46.7521	0.6000		0.7000		0.7700		54.4306
West					14.7500	19.6403	0.6000		0.7000		0.7700		84.3183 (80)
Solar gains	138.7489	254.0878	385.1929	524.5102	619.2598	625.7226	598.9336	528.5786	434.5480	291.8700	169.6539	116.3723	(83)
Total gains	506.1521	619.5420	738.2973	857.7136	932.3337	919.3063	879.7892	815.0591	731.1896	608.6134	509.5043	473.4792	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	93.0115	93.3958	93.7832	95.7695	96.1769	98.2670	98.2670	98.6960	97.4202	96.1769	95.3655	94.5677	
alpha	7.2008	7.2264	7.2522	7.3846	7.4118	7.5511	7.5511	7.5797	7.4947	7.4118	7.3577	7.3045	
util living area	0.9806	0.9351	0.8153	0.6114	0.4348	0.2973	0.2136	0.2400	0.4063	0.7222	0.9444	0.9865 (86)	
MIT	20.5685	20.7579	20.9210	20.9900	20.9992	21.0000	21.0000	21.0000	20.9996	20.9758	20.7802	20.5316 (87)	
Th 2	20.3948	20.3972	20.3995	20.4113	20.4137	20.4255	20.4255	20.4278	20.4208	20.4137	20.4090	20.4043 (88)	
util rest of house	0.9763	0.9233	0.7920	0.5833	0.4076	0.2707	0.1857	0.2102	0.3723	0.6875	0.9322	0.9834 (89)	
MIT 2	20.0055	20.1884	20.3368	20.4043	20.4132	20.4255	20.4255	20.4278	20.4206	20.3970	20.2225	19.9779 (90)	
Living area fraction									fLA = Living area / (4) =			0.2635 (91)	
MIT	20.1538	20.3384	20.4907	20.5586	20.5676	20.5768	20.5768	20.5786	20.5731	20.5495	20.3694	20.1238 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.1538	20.3384	20.4907	20.5586	20.5676	20.5768	20.5768	20.5786	20.5731	20.5495	20.3694	20.1238 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9743	0.9221	0.7956	0.5904	0.4147	0.2777	0.1931	0.2180	0.3813	0.6957	0.9313	0.9816 (94)
Useful gains	493.1382	571.2611	587.4246	506.4100	386.6695	255.2848	169.8679	177.7085	278.7739	423.4018	474.5135	464.7907 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	715.4487	693.8375	626.1764	510.9771	387.0044	255.2963	169.8684	177.7099	278.8998	434.2225	584.0391	706.7814 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	165.3990	82.3714	28.8314	3.2883	0.2491	0.0000	0.0000	0.0000	0.0000	8.0506	78.8584	180.0411 (98)
Space heating												547.0892 (98)
Space heating per m2												7.7491 (99)
										(98) / (4) =		

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (301)
Fraction of space heat from community system	1.0000 (302)
Fraction of heat from community Heat pump	1.0000 (303a)
Fraction of total space heat from community Heat pump	1.0000 (304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0500 (305)
Distribution loss factor (Table 12c) for community heating system	1.0000 (306)
Space heating:	
Annual space heating requirement	547.0892 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.00	574.4436 (307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000 (309)
Water heating	
Annual water heating requirement	1711.4872 (64)
Fraction of heat from community Heat pump	1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system	1.0000 (306)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.00	1711.4872 (310a)
Electricity used for heat distribution (space)	5.7444 (313)
Electricity used for heat distribution (water)	17.1149 (313)
Annual totals kWh/year	
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)	
mechanical ventilation fans (SFP = 0.5250)	113.0483 (330a)
Total electricity for the above, kWh/year	113.0483 (331)
Electricity for lighting (calculated in Appendix L)	312.8287 (332)
Total delivered energy for all uses	2711.8078 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			330.0000 (367a)
Space heating from Heat pump	174.0738	0.5190	90.3443 (367)
Efficiency of heat source Heat pump			440.0000 (367a)
Space heating from Heat pump	388.9744	0.5190	201.8777 (367)
Electrical energy for heat distribution (space)	5.7444	0.5190	2.9814 (372)
Electrical energy for heat distribution (water)	17.1149	0.5190	8.8826 (372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			304.0860 (373)
Space and water heating			304.0860 (376)
Pumps and fans	113.0483	0.5190	58.6720 (378)
Energy for lighting	312.8287	0.5190	162.3581 (379)
Total CO2, kg/year			525.1161 (383)
Dwelling Carbon Dioxide Emission Rate (DER)			7.4400 (384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		7.4400 ZC1
Total Floor Area	TFA	70.6000
Assumed number of occupants	N	2.2606
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		16.6773 ZC2
CO2 emissions from cooking, equation (L16)		2.4540 ZC3
Total CO2 emissions		26.5713 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		26.5713 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour
Pressure test					30.0000 / (5) = 0.1700 (8)
Measured/design AP50					Yes
Infiltration rate					5.0000
Number of sides sheltered					0.4200 (18)
					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3570 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4551	0.4462	0.4373	0.3927	0.3837	0.3391	0.3391	0.3302	0.3570	0.3837	0.4016	0.4194 (22b)
Effective ac	0.6036	0.5996	0.5956	0.5771	0.5736	0.5575	0.5575	0.5545	0.5637	0.5736	0.5806	0.5880 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opening Type (Uw = 1.40)			17.6700	1.3258	23.4261		(27)
External Wall 1	46.2500	17.6700	28.5800	0.1800	5.1444		(29a)
Total net area of external elements Aum(A, m ²)			46.2500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		28.5705		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000 (36)
Total fabric heat loss						(33) + (36) =	28.5705 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	35.1554	34.9211	34.6915	33.6130	33.4112	32.4718	32.4718
Heat transfer coeff	63.7259	63.4917	63.2621	62.1835	61.9817	61.0423	61.0423
Average = Sum(39)m / 12 =						60.8684	61.4042
						61.4042	61.9817
						62.3899	62.8167 (39)
							62.1825 (39)
HLP	0.9026	0.8993	0.8961	0.8808	0.8779	0.8646	0.8646
HLP (average)						0.8622	0.8697
Days in month	31	28	31	30	31	30	31
						30	31
						30	30
						31	31
						30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
Daily hot water use	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)										Total = Sum(45)m =		1382.8412 (45)
Distribution loss (46)m = 0.15 x (45)m												
21.5057	18.8090	19.4092	16.9214	16.2365	14.0109	12.9831	14.8983	15.0762	17.5699	19.1789	20.8271 (46)	
Water storage loss:												
Store volume												15.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												0.4337 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.2342 (55)
Total storage loss												
7.2595	6.5570	7.2595	7.0253	7.2595	7.0253	7.2595	7.2595	7.0253	7.2595	7.0253	7.2595 (56)	
If cylinder contains dedicated solar storage												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Primary loss	7.2595	6.5570	7.2595	7.0253	7.2595	7.0253	7.2595	7.2595	7.0253	7.2595	7.0253	7.2595 (57)
Total heat required for water heating calculated for each month	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Solar input	173.8930	152.9614	159.9165	142.3467	138.7652	122.9430	117.0760	129.8440	130.0457	147.6547	157.3969	169.3691 (62)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Heat gains from water heating, kWh/month	173.8930	152.9614	159.9165	142.3467	138.7652	122.9430	117.0760	129.8440	130.0457	147.6547	157.3969	169.3691 (64)
	72.0884	63.7478	67.4412	61.1390	60.4084	54.6873	53.1968	57.4421	57.0489	63.3642	66.1432	70.5842 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	(71)
Water heating gains (Table 5)	96.8930	94.8628	90.6468	84.9153	81.1941	75.9545	71.5011	77.2072	79.2346	85.1669	91.8655	94.8713	(72)
Total internal gains	373.2091	371.2601	358.9104	339.0094	318.8799	299.3896	286.6616	292.2864	302.4476	322.5494	345.6563	362.9128	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
South					3.7700	46.7521	0.6300	0.7000			0.7700	53.8659
West					13.9000	19.6403	0.6300	0.7000			0.7700	83.4322 (78)
Solar gains	137.2982	251.4296	381.1602	519.0155	612.7701	619.1644	592.6565	523.0403	429.9974	288.8157	167.8797	115.1557 (83)
Total gains	510.5072	622.6898	740.0706	858.0249	931.6500	918.5540	879.3181	815.3268	732.4450	611.3651	513.5360	478.0685 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	76.9353	77.2192	77.4995	78.8437	79.1004	80.3177	80.3177	80.5472	79.8444	79.1004	78.5828	78.0489	
alpha	6.1290	6.1479	6.1666	6.2562	6.2734	6.3545	6.3545	6.3698	6.3230	6.2734	6.2389	6.2033	
util living area	0.9942	0.9809	0.9345	0.7997	0.6067	0.4242	0.3053	0.3432	0.5707	0.8843	0.9841	0.9960	(86)
MIT	20.2245	20.4265	20.6852	20.9073	20.9844	20.9986	20.9999	20.9997	20.9920	20.8544	20.4941	20.1912	(87)
Th 2	20.1653	20.1681	20.1708	20.1839	20.1863	20.1977	20.1977	20.1998	20.1933	20.1863	20.1814	20.1762	(88)
util rest of house	0.9924	0.9754	0.9179	0.7626	0.5577	0.3716	0.2497	0.2836	0.5072	0.8499	0.9787	0.9947	(89)
MIT 2	19.1362	19.4290	19.7919	20.0869	20.1731	20.1969	20.1976	20.1997	20.1879	20.0334	19.5393	19.0962	(90)
Living area fraction	19.4229	19.6918	20.0272	20.3031	20.3868	20.4081	20.4090	20.4104	20.3997	20.2497	19.7908	19.3847	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4229	19.6918	20.0272	20.3031	20.3868	20.4081	20.4090	20.4104	20.3997	20.2497	19.7908	19.3847	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9903	0.9716	0.9147	0.7683	0.5700	0.3854	0.2644	0.2993	0.5237	0.8529	0.9753	0.9931	(94)
Ext temp.	505.5669	604.9760	676.9148	659.2485	530.9983	354.0248	232.4725	244.0306	383.5761	521.4193	500.8709	474.7610	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	963.7217	939.1573	855.7610	709.0823	538.4247	354.5389	232.5090	244.1095	386.8295	598.1070	791.7806	953.8534	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m2	340.8672	224.5699	133.0616	35.8804	5.5252	0.0000	0.0000	0.0000	0.0000	57.0557	209.4550	356.4448	(98)
												1362.8597	(98)
												19.3040	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1457.6039 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	340.8672	224.5699	133.0616	35.8804	5.5252	0.0000	0.0000	0.0000	0.0000	57.0557	209.4550	356.4448	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	364.5639	240.1817	142.3119	38.3747	5.9093	0.0000	0.0000	0.0000	0.0000	61.0221	224.0160	381.2244	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	173.8930	152.9614	159.9165	142.3467	138.7652	122.9430	117.0760	129.8440	130.0457	147.6547	157.3969	169.3691	(64)
Efficiency of water heater	86.5784	85.8368	84.3282	81.7457	80.1629	79.8000	79.8000	79.8000	79.8000	82.5193	85.5769	79.8000	(216)
(217)m	86.5784	85.8368	84.3282	81.7457	80.1629	79.8000	79.8000	79.8000	79.8000	82.5193	85.5769	86.7531	(217)
Fuel for water heating, kWh/month	200.8504	178.2003	189.6359	174.1335	173.1039	154.0640	146.7118	162.7118	162.9645	178.9336	183.9246	195.2311	(219)
Water heating fuel used												2100.4655	(219)
Annual totals kWh/year													
Space heating fuel - main system												1457.6039	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												312.8287	(232)
Total delivered energy for all uses												3945.8981	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1457.6039	0.2160	314.8425 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2100.4655	0.2160	453.7005 (264)
Space and water heating			768.5430 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	312.8287	0.5190	162.3581 (268)
Total CO2, kg/m2/year			969.8261 (272)
Emissions per m2 for space and water heating			10.8859 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			2.2997 (272b)
Emissions per m2 for pumps and fans			0.5513 (272c)
Target Carbon Dioxide Emission Rate (TER) = (10.8859 * 1.55) + 2.2997 + 0.5513, rounded to 2 d.p.			19.7200 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1700 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.3200 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2720 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.3468	0.3400	0.3332	0.2992	0.2924	0.2584	0.2584	0.2516	0.2720	0.2924	0.3060	0.3196 (22b)
	0.5601	0.5578	0.5555	0.5448	0.5427	0.5334	0.5334	0.5316	0.5370	0.5427	0.5468	0.5511 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
windows (Uw = 1.20)			18.7500	1.1450	21.4695			(27)
External Wall 1	46.2500	18.7500	27.5000	0.1500	4.1250	70.0000	1925.0000	(29a)
Total net area of external elements Aum(A, m2)			46.2500					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	25.5945		(33)
Party Wall hall			13.7500	0.0000	0.0000	180.0000	2475.0000	(32)
Party Wall flat			32.5000	0.0000	0.0000	110.0000	3575.0000	(32)
Party Floor 1			70.6000			40.0000	2824.0000	(32d)
Party Ceilings 1			70.6000			30.0000	2118.0000	(32b)
Internal Wall 1			165.3000			9.0000	1487.7000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14404.7000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							204.0326	(35)
Thermal bridges (User defined value 0.075 * total exposed area)							3.4688	(36)
Total fabric heat loss					(33) + (36) =		29.0632	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	32.6244	32.4885	32.3552	31.7291	31.6120	31.0667	31.0667	30.9657	31.2767	31.6120	31.8489	32.0967 (38)
Heat transfer coeff	61.6877	61.5517	61.4184	60.7923	60.6752	60.1299	60.1299	60.0289	60.3399	60.6752	60.9121	61.1599 (39)
Average = Sum(39)m / 12 =												60.7918 (39)
HLP	0.8738	0.8718	0.8699	0.8611	0.8594	0.8517	0.8517	0.8503	0.8547	0.8594	0.8628	0.8663 (40)
HLP (average)												0.8611 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
Daily hot water use	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)										Total = Sum(45)m =		1382.8412 (45)
Distribution loss (46)m = 0.15 x (45)m												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	30.4663	26.6461	27.4964	23.9720	23.0017	19.8487	18.3927	21.1059	21.3580	24.8907	27.1702	29.5050 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	(71)
Water heating gains (Table 5)	40.9494	39.6519	36.9575	33.2944	30.9163	27.5677	24.7214	28.3682	29.6639	33.4553	37.7363	39.6573	(72)
Total internal gains	314.2654	313.0492	302.2210	284.3885	265.6020	248.0027	236.8820	240.4475	249.8770	267.8377	288.5271	304.6988	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
South				4.0000	46.7521		0.6000		0.7000		0.7700		54.4306 (78)
West				14.7500	19.6403		0.6000		0.7000		0.7700		84.3183 (80)
Solar gains	138.7489	254.0878	385.1929	524.5102	619.2598	625.7226	598.9336	528.5786	434.5480	291.8700	169.6539	116.3723	(83)
Total gains	453.0144	567.1370	687.4139	808.8987	884.8618	873.7253	835.8156	769.0260	684.4249	559.7077	458.1810	421.0711	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	64.8639	65.0073	65.1483	65.8193	65.9463	66.5444	66.5444	66.6563	66.3127	65.9463	65.6898	65.4237	
alpha	5.3243	5.3338	5.3432	5.3880	5.3964	5.4363	5.4363	5.4438	5.4208	5.3964	5.3793	5.3616	
util living area	0.9929	0.9776	0.9291	0.8008	0.6161	0.4376	0.3161	0.3582	0.5915	0.8895	0.9828	0.9950	(86)
MIT	20.0401	20.2776	20.5830	20.8543	20.9683	20.9958	20.9994	20.9989	20.9809	20.7791	20.3428	19.9919	(87)
Th 2	20.1899	20.1915	20.1931	20.2007	20.2021	20.2088	20.2088	20.2100	20.2062	20.2021	20.1993	20.1963	(88)
util rest of house	0.9911	0.9722	0.9139	0.7673	0.5693	0.3847	0.2595	0.2971	0.5295	0.8601	0.9778	0.9938	(89)
MIT 2	19.3113	19.5465	19.8409	20.0908	20.1821	20.2068	20.2086	20.2096	20.1962	20.0342	19.6191	19.2687	(90)
Living area fraction	19.5033	19.7391	20.0364	20.2919	20.3892	20.4147	20.4169	20.4176	20.4029	20.2304	19.8098	19.4592	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5033	19.7391	20.0364	20.2919	20.3892	20.4147	20.4169	20.4176	20.4029	20.2304	19.8098	19.4592	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9892	0.9686	0.9105	0.7714	0.5805	0.3985	0.2744	0.3132	0.5452	0.8612	0.9748	0.9923	(94)
Useful gains	448.1012	549.3423	625.9078	623.9690	513.6952	348.1886	229.3636	240.8690	373.1615	482.0396	446.6461	417.8102	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	937.8561	913.3724	831.3829	692.5415	527.2196	349.6358	229.5115	241.1693	380.3173	584.3279	774.1810	933.2535	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	364.3776	244.6282	152.8735	49.3722	10.0621	0.0000	0.0000	0.0000	0.0000	76.1025	235.8251	383.4898	(98)
Space heating												1516.7311	(98)
Space heating per m2										(98) / (4) =		21.4834	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	565.2210	444.9612	456.2198	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9871	0.9948	0.9917	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	557.9125	442.6399	452.4389	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1105.1954	1059.1833	982.4709	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	394.0437	458.7083	394.3438	0.0000	0.0000	0.0000	0.0000	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												1247.0958 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)	
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	98.5109	114.6771	98.5860	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												311.7739 (107)
Space cooling per m2												4.4161 (108)
Energy for space heating												21.4834 (99)
Energy for space cooling												4.4161 (108)
Total												25.8995 (109)
Dwelling Fabric Energy Efficiency (DFEE)												25.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour
Pressure test					30.0000 / (5) = 0.1700 (8)
Measured/design AP50					Yes
Infiltration rate					5.0000
Number of sides sheltered					0.4200 (18)
					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3570 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
	0.4551	0.4462	0.4373	0.3927	0.3837	0.3391	0.3391	0.3302	0.3570	0.3837	0.4016	0.4194 (22b)
Effective ac	0.6036	0.5996	0.5956	0.5771	0.5736	0.5575	0.5575	0.5545	0.5637	0.5736	0.5806	0.5880 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opening Type (Uw = 1.40)			17.6700	1.3258	23.4261			(27)					
External Wall 1	46.2500	17.6700	28.5800	0.1800	5.1444			(29a)					
Total net area of external elements Aum(A, m2)			46.2500					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	28.5705			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								0.0000 (36)					
Total fabric heat loss						(33) + (36) =		28.5705 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.1554	34.9211	34.6915	33.6130	33.4112	32.4718	32.4718	32.2978	32.8336	33.4112	33.8194	34.2462	(38)
Heat transfer coeff	63.7259	63.4917	63.2621	62.1835	61.9817	61.0423	61.0423	60.8684	61.4042	61.9817	62.3899	62.8167	(39)
Average = Sum(39)m / 12 =												62.1825	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9026	0.8993	0.8961	0.8808	0.8779	0.8646	0.8646	0.8622	0.8697	0.8779	0.8837	0.8898	(40)
HLP (average)												0.8808	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)											Total = Sum(45)m =	1382.8412 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.4663	26.6461	27.4964	23.9720	23.0017	19.8487	18.3927	21.1059	21.3580	24.8907	27.1702	29.5050 (65)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	(71)
Water heating gains (Table 5)	40.9494	39.6519	36.9575	33.2944	30.9163	27.5677	24.7214	28.3682	29.6639	33.4553	37.7363	39.6573	(72)
Total internal gains	314.2654	313.0492	302.2210	284.3885	265.6020	248.0027	236.8820	240.4475	249.8770	267.8377	288.5271	304.6988	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c	Access factor Table 6d		Gains W	
South					3.7700	46.7521	0.6300		0.7000	0.7700		53.8659	
West					13.9000	19.6403	0.6300		0.7000	0.7700		83.4322 (80)	
Solar gains	137.2982	251.4296	381.1602	519.0155	612.7701	619.1644	592.6565	523.0403	429.9974	288.8157	167.8797	115.1557	(83)
Total gains	451.5636	564.4789	683.3812	803.4040	878.3722	867.1671	829.5385	763.4878	679.8743	556.6534	456.4068	419.8545	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, nil,m (see Table 9a)													21.0000 (85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	76.9353	77.2192	77.4995	78.8437	79.1004	80.3177	80.3177	80.5472	79.8444	79.1004	78.5828	78.0489	
alpha	6.1290	6.1479	6.1666	6.2562	6.2734	6.3545	6.3545	6.3698	6.3230	6.2734	6.2389	6.2033	
util living area	0.9970	0.9882	0.9528	0.8324	0.6394	0.4489	0.3236	0.3663	0.6110	0.9171	0.9913	0.9980	(86)
MIT	20.1447	20.3527	20.6287	20.8829	20.9793	20.9981	20.9998	20.9996	20.9884	20.8123	20.4201	20.1114	(87)
Th 2	20.1653	20.1681	20.1708	20.1839	20.1863	20.1977	20.1977	20.1998	20.1933	20.1863	20.1814	20.1762	(88)
util rest of house	0.9960	0.9846	0.9397	0.7976	0.5890	0.3934	0.2647	0.3028	0.5446	0.8890	0.9881	0.9974	(89)
MIT 2	19.3834	19.5916	19.8603	20.0987	20.1742	20.1969	20.1976	20.1997	20.1878	20.0473	19.6708	19.3595	(90)
Living area fraction	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(91)
MIT	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	449.3762	554.6914	640.8741	645.2126	528.4413	353.8185	232.4564	243.9910	381.9811	496.2157	450.2624	418.4905	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	973.9856	945.5245	858.0078	709.2221	538.3909	354.5323	232.5081	244.1073	386.7685	598.0518	796.6090	964.7165	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	390.3094	262.6399	161.5475	46.0869	7.4025	0.0000	0.0000	0.0000	0.0000	75.7661	249.3695	406.3922	(98)
Space heating												1599.5139	(98)
Space heating per m ²												22.6560	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	573.7979	451.7133	462.5996	0.0000	0.0000	0.0000	0.0000	(100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9922	0.9973	0.9955	0.0000	0.0000	0.0000	0.0000	(101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	569.3171	450.5128	460.4977	0.0000	0.0000	0.0000	0.0000	(102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1097.5299	1051.8464	975.9976	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling						380.3132	447.3922	383.5319	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction												1211.2374	(105)
Intermittency factor (Table 10b)												1.0000	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling per m ²	0.0000	0.0000	0.0000	0.0000	0.0000	95.0783	111.8481	95.8830	0.0000	0.0000	0.0000	0.0000	(107)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling	302.8093 (107)
Space cooling per m2	4.2891 (108)
Energy for space heating	22.6560 (99)
Energy for space cooling	4.2891 (108)
Total	26.9451 (109)
Target Fabric Energy Efficiency (TFEE)	31.0 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	Avondale A.02.007			Issued on Date	25/11/2021
Assessment Reference	Avondale A02.007	Prop Type Ref	Avondale Phase 1a		
Property					
SAP Rating	94 A	DER	-0.82	TER	19.72
Environmental	101 A	% DER<TER	104.16		
CO ₂ Emissions (t/year)	-0.16	DFEE	25.90	TFEE	30.99
General Requirements Compliance	Pass	% DFEE<TFEE	16.42		
Assessor Details	Mr. William O'Reilly, Synergy Consulting Engineers Limited, Tel: 02075298950, william.oreilly@synconsult.co.uk			Assessor ID	H824-0001
Client					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Top-floor flat, total floor area 71 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating:Electricity (c)

Fuel factor:1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 19.72 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) -0.82 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)31.0 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)25.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.075

3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system:	Community heating scheme	-
Secondary heating system:	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 0.25 kWh/day	
Permitted by DBSCG 0.59	OK	
Primary pipework insulated:	Yes (assumed)	OK

6 Controls

Space heating controls:	Flat rate charging, programmer and at least two room thermostatsOK	
Hot water controls:	Cylinderstat	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%		
Minimum	75%	OK

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.42	
Maximum	1.5	OK
MVHR efficiency:	91%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing South:	4.00 m ² , No overhang	
Windows facing West:	14.75 m ² , No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	None	

10 Key features

Party wall U-value	0.00 W/m ² K
Party wall U-value	0.00 W/m ² K
Air permeability	3.0 m ³ /m ² h
Photovoltaic array	1.30 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					0 * 10 = 0.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				0.0000 / (5) = 0.0000 (8)							
Pressure test					Yes							
Measured/design AP50					3.0000							
Infiltration rate					0.1500 (18)							
Number of sides sheltered					2 (19)							
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)							
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.1275 (21)							
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation:												0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												77.3500 (23c)
Effective ac	0.2758	0.2726	0.2694	0.2535	0.2503	0.2344	0.2344	0.2312	0.2408	0.2503	0.2567	0.2631 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
windows (Uw = 1.20)			18.7500	1.1450	21.4695			(27)					
External Wall 1	46.2500	18.7500	27.5000	0.1500	4.1250	70.0000	1925.0000	(29a)					
Total net area of external elements Aum(A, m2)			46.2500					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		25.5945			(33)					
Party Wall hall			13.7500	0.0000	0.0000	180.0000	2475.0000	(32)					
Party Wall flat			32.5000	0.0000	0.0000	110.0000	3575.0000	(32)					
Party Floor 1			70.6000			40.0000	2824.0000	(32d)					
Party Ceilings 1			70.6000			40.0000	2824.0000	(32b)					
Internal Wall 1			165.3000			9.0000	1487.7000	(32c)					
Heat capacity Cm = Sum(A x k)					(28) ... (30) + (32) + (32a) ... (32e) =		15110.7000	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							214.0326	(35)					
Thermal bridges (User defined value 0.075 * total exposed area)							3.4688	(36)					
Total fabric heat loss						(33) + (36) =	29.0632	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 16.0647	Feb 15.8790	Mar 15.6934	Apr 14.7651	May 14.5795	Jun 13.6512	Jul 13.6512	Aug 13.4655	Sep 14.0225	Oct 14.5795	Nov 14.9508	Dec 15.3221	(38)
Heat transfer coeff	45.1279	44.9423	44.7566	43.8283	43.6427	42.7144	42.7144	42.5287	43.0857	43.6427	44.0140	44.3853	(39)
Average = Sum(39)m / 12 =												43.7819	(39)
HLP	Jan 0.6392	Feb 0.6366	Mar 0.6339	Apr 0.6208	May 0.6182	Jun 0.6050	Jul 0.6050	Aug 0.6024	Sep 0.6103	Oct 0.6182	Nov 0.6234	Dec 0.6287	(40)
HLP (average)												0.6201	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
Daily hot water use	Jan 96.6783	Feb 93.1627	Mar 89.6471	Apr 86.1315	May 82.6160	Jun 79.1004	Jul 79.1004	Aug 82.6160	Sep 86.1315	Oct 89.6471	Nov 93.1627	Dec 96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)										Total = Sum(45)m =		1382.8412 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	21.5057	18.8090	19.4092	16.9214	16.2365	14.0109	12.9831	14.8983	15.0762	17.5699	19.1789	20.8271 (46)
Water storage loss:												
Store volume												15.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												0.2500 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.1500 (55)
Total storage loss												
4.6500 4.2000 4.6500 4.5000 4.6500 4.5000 4.6500 4.6500 4.5000 4.6500 4.5000 4.6500 (56)												
If cylinder contains dedicated solar storage												
4.6500 4.2000 4.6500 4.5000 4.6500 4.5000 4.6500 4.6500 4.5000 4.6500 4.5000 4.6500 (57)												
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)												
Total heat required for water heating calculated for each month												
171.2835 150.6044 157.3070 139.8213 136.1556 120.4177 114.4665 127.2345 127.5203 145.0452 154.8716 166.7596 (62)												
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)												
Solar input (sum of months) = Sum(63)m =												
Output from w/h												
171.2835 150.6044 157.3070 139.8213 136.1556 120.4177 114.4665 127.2345 127.5203 145.0452 154.8716 166.7596 (64)												
Total per year (kWh/year) = Sum(64)m =												1711.4872 (64)
Heat gains from water heating, kWh/month												
70.0008 61.8622 65.3536 59.1187 58.3208 52.6670 51.1092 55.3545 55.0286 61.2766 64.1229 68.4966 (65)												

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
17.7137 15.7331 12.7950 9.6867 7.2409 6.1131 6.6054 8.5859 11.5240 14.6324 17.0781 18.2060 (67)												
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
198.6934 200.7552 195.5595 184.4984 170.5358 157.4130 148.6461 146.5843 151.7800 162.8410 176.8036 189.9265 (68)												
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 34.3030 (69)												
Pumps, fans 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (70)												
Losses e.g. evaporation (negative values) (Table 5)												
-90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 -90.4241 (71)												
Water heating gains (Table 5)												
94.0871 92.0569 87.8409 82.1093 78.3882 73.1486 68.6951 74.4012 76.4286 82.3610 89.0596 92.0653 (72)												
Total internal gains												
367.4031 365.4542 353.1044 333.2034 313.0739 293.5837 280.8556 286.4805 296.6417 316.7434 339.8504 357.1068 (73)												

6. Solar gains

[Jan]												Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
South												4.0000	46.7521	0.6000	0.7000	0.7700	54.4306
West												14.7500	19.6403	0.6000	0.7000	0.7700	84.3183 (80)
Solar gains	138.7489	254.0878	385.1929	524.5102	619.2598	625.7226	598.9336	528.5786	434.5480	291.8700	169.6539	116.3723	(83)				
Total gains	506.1521	619.5420	738.2973	857.7136	932.3337	919.3063	879.7892	815.0591	731.1896	608.6134	509.5043	473.4792	(84)				

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	93.0115	93.3958	93.7832	95.7695	96.1769	98.2670	98.2670	98.6960	97.4202	96.1769	95.3655	94.5677
alpha	7.2008	7.2264	7.2522	7.3846	7.4118	7.5511	7.5511	7.5797	7.4947	7.4118	7.3577	7.3045
util living area	0.9806	0.9351	0.8153	0.6114	0.4348	0.2973	0.2136	0.2400	0.4063	0.7222	0.9444	0.9865 (86)
MIT	20.5685	20.7579	20.9210	20.9900	20.9992	21.0000	21.0000	21.0000	20.9996	20.9758	20.7802	20.5316 (87)
Th 2	20.3948	20.3972	20.3995	20.4113	20.4137	20.4255	20.4255	20.4278	20.4208	20.4137	20.4090	20.4043 (88)
util rest of house	0.9763	0.9233	0.7920	0.5833	0.4076	0.2707	0.1857	0.2102	0.3723	0.6875	0.9322	0.9834 (89)
MIT 2	20.0055	20.1884	20.3368	20.4043	20.4132	20.4255	20.4255	20.4278	20.4206	20.3970	20.2225	19.9779 (90)
Living area fraction									fLA = Living area / (4) =			0.2635 (91)
MIT	20.1538	20.3384	20.4907	20.5586	20.5676	20.5768	20.5768	20.5786	20.5731	20.5495	20.3694	20.1238 (92)
Temperature adjustment												0.0000
adjusted MIT	20.1538	20.3384	20.4907	20.5586	20.5676	20.5768	20.5768	20.5786	20.5731	20.5495	20.3694	20.1238 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.9743 0.9221 0.7956 0.5904 0.4147 0.2777 0.1931 0.2180 0.3813 0.6957 0.9313 0.9816 (94)												
Useful gains 493.1382 571.2611 587.4246 506.4100 386.6695 255.2848 169.8679 177.7085 278.7739 423.4018 474.5135 464.7907 (95)												
Ext temp. 4.3000 4.9000 6.5000 8.9000 11.7000 14.6000 16.6000 16.4000 14.1000 10.6000 7.1000 4.2000 (96)												
Heat loss rate W												
715.4487 693.8375 626.1764 510.9771 387.0044 255.2963 169.8684 177.7099 278.8998 434.2225 584.0391 706.7814 (97)												
Month fracti 1.0000 1.0000 1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000 1.0000 1.0000 (97a)												
Space heating kWh												
165.3990 82.3714 28.8314 3.2883 0.2491 0.0000 0.0000 0.0000 0.0000 8.0506 78.8584 180.0411 (98)												
Space heating												547.0892 (98)
Space heating per m2												7.7491 (99)
(98) / (4) =												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0500	(305)
Distribution loss factor (Table 12c) for community heating system	1.0000	(306)
Space heating:		
Annual space heating requirement	547.0892	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.00	574.4436	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1711.4872	(64)
Fraction of heat from community Heat pump	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0000	(306)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.00	1711.4872	(310a)
Electricity used for heat distribution (space)	5.7444	(313)
Electricity used for heat distribution (water)	17.1149	(313)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)		
mechanical ventilation fans (SFP = 0.5250)	113.0483	(330a)
Total electricity for the above, kWh/year	113.0483	(331)
Electricity for lighting (calculated in Appendix L)	312.8287	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.30 * 1080 * 1.00) =	-1122.7056	(333)
Total delivered energy for all uses	1589.1022	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			330.0000 (367a)
Space heating from Heat pump	174.0738	0.5190	90.3443 (367)
Efficiency of heat source Heat pump			440.0000 (367a)
Space heating from Heat pump	388.9744	0.5190	201.8777 (367)
Electrical energy for heat distribution (space)	5.7444	0.5190	2.9814 (372)
Electrical energy for heat distribution (water)	17.1149	0.5190	8.8826 (372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			304.0860 (373)
Space and water heating			304.0860 (376)
Pumps and fans	113.0483	0.5190	58.6720 (378)
Energy for lighting	312.8287	0.5190	162.3581 (379)
Energy saving/generation technologies			
PV Unit	-1122.7056	0.5190	-582.6842 (380)
Total CO2, kg/year			-57.5681 (383)
Dwelling Carbon Dioxide Emission Rate (DER)			-0.8200 (384)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER			-0.8200 ZC1
Total Floor Area		TFA	70.6000
Assumed number of occupants		N	2.2606
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			16.6773 ZC2
CO2 emissions from cooking, equation (L16)			2.4540 ZC3
Total CO2 emissions			18.3113 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			18.3113 ZC8

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)
								Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						30.0000 / (5) =	0.1700	(8)
Pressure test							Yes		
Measured/design AP50								5.0000	
Infiltration rate								0.4200	(18)
Number of sides sheltered								2	(19)
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.3570	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
	0.4551	0.4462	0.4373	0.3927	0.3837	0.3391	0.3391	0.3302	0.3570	0.3837	0.4016	0.4194 (22b)
Effective ac	0.6036	0.5996	0.5956	0.5771	0.5736	0.5575	0.5575	0.5545	0.5637	0.5736	0.5806	0.5880 (25)

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opening Type (Uw = 1.40)			17.6700	1.3258	23.4261			(27)					
External Wall 1	46.2500	17.6700	28.5800	0.1800	5.1444			(29a)					
Total net area of external elements Aum(A, m2)			46.2500					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	28.5705			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								0.0000 (36)					
Total fabric heat loss						(33) + (36) =	28.5705	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.1554	34.9211	34.6915	33.6130	33.4112	32.4718	32.4718	32.2978	32.8336	33.4112	33.8194	34.2462	(38)
Heat transfer coeff	63.7259	63.4917	63.2621	62.1835	61.9817	61.0423	61.0423	60.8684	61.4042	61.9817	62.3899	62.8167	(39)
Average = Sum(39)m / 12 =												62.1825	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9026	0.8993	0.8961	0.8808	0.8779	0.8646	0.8646	0.8622	0.8697	0.8779	0.8837	0.8898	(40)
HLP (average)												0.8808	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy content (annual)	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Distribution loss (46)m = 0.15 x (45)m	Total = Sum(45)m =											1382.8412 (45)
	21.5057	18.8090	19.4092	16.9214	16.2365	14.0109	12.9831	14.8983	15.0762	17.5699	19.1789	20.8271 (46)
Water storage loss:												
Store volume												15.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												0.4337 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.2342 (55)
Total storage loss												
	7.2595	6.5570	7.2595	7.0253	7.2595	7.0253	7.2595	7.2595	7.0253	7.2595	7.0253	7.2595 (56)
If cylinder contains dedicated solar storage												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Primary loss	7.2595	6.5570	7.2595	7.0253	7.2595	7.0253	7.2595	7.2595	7.0253	7.2595	7.0253	7.2595 (57)
Total heat required for water heating calculated for each month	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Solar input	173.8930	152.9614	159.9165	142.3467	138.7652	122.9430	117.0760	129.8440	130.0457	147.6547	157.3969	169.3691 (62)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Heat gains from water heating, kWh/month	173.8930	152.9614	159.9165	142.3467	138.7652	122.9430	117.0760	129.8440	130.0457	147.6547	157.3969	169.3691 (64)
	72.0884	63.7478	67.4412	61.1390	60.4084	54.6873	53.1968	57.4421	57.0489	63.3642	66.1432	70.5842 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	(71)
Water heating gains (Table 5)	96.8930	94.8628	90.6468	84.9153	81.1941	75.9545	71.5011	77.2072	79.2346	85.1669	91.8655	94.8713	(72)
Total internal gains	373.2091	371.2601	358.9104	339.0094	318.8799	299.3896	286.6616	292.2864	302.4476	322.5494	345.6563	362.9128	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
South					3.7700	46.7521	0.6300	0.7000			0.7700	53.8659
West					13.9000	19.6403	0.6300	0.7000			0.7700	83.4322 (78)
Solar gains	137.2982	251.4296	381.1602	519.0155	612.7701	619.1644	592.6565	523.0403	429.9974	288.8157	167.8797	115.1557 (83)
Total gains	510.5072	622.6898	740.0706	858.0249	931.6500	918.5540	879.3181	815.3268	732.4450	611.3651	513.5360	478.0685 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	76.9353	77.2192	77.4995	78.8437	79.1004	80.3177	80.3177	80.5472	79.8444	79.1004	78.5828	78.0489	
alpha	6.1290	6.1479	6.1666	6.2562	6.2734	6.3545	6.3545	6.3698	6.3230	6.2734	6.2389	6.2033	
util living area	0.9942	0.9809	0.9345	0.7997	0.6067	0.4242	0.3053	0.3432	0.5707	0.8843	0.9841	0.9960	(86)
MIT	20.2245	20.4265	20.6852	20.9073	20.9844	20.9986	20.9999	20.9997	20.9920	20.8544	20.4941	20.1912	(87)
Th 2	20.1653	20.1681	20.1708	20.1839	20.1863	20.1977	20.1977	20.1998	20.1933	20.1863	20.1814	20.1762	(88)
util rest of house	0.9924	0.9754	0.9179	0.7626	0.5577	0.3716	0.2497	0.2836	0.5072	0.8499	0.9787	0.9947	(89)
MIT 2	19.1362	19.4290	19.7919	20.0869	20.1731	20.1969	20.1976	20.1997	20.1879	20.0334	19.5393	19.0962	(90)
Living area fraction	19.4229	19.6918	20.0272	20.3031	20.3868	20.4081	20.4090	20.4104	20.3997	20.2497	19.7908	19.3847	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4229	19.6918	20.0272	20.3031	20.3868	20.4081	20.4090	20.4104	20.3997	20.2497	19.7908	19.3847	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9903	0.9716	0.9147	0.7683	0.5700	0.3854	0.2644	0.2993	0.5237	0.8529	0.9753	0.9931	(94)
Ext temp.	505.5669	604.9760	676.9148	659.2485	530.9983	354.0248	232.4725	244.0306	383.5761	521.4193	500.8709	474.7610	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	963.7217	939.1573	855.7610	709.0823	538.4247	354.5389	232.5090	244.1095	386.8295	598.1070	791.7806	953.8534	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m2	340.8672	224.5699	133.0616	35.8804	5.5252	0.0000	0.0000	0.0000	0.0000	57.0557	209.4550	356.4448	(98)
												1362.8597	(98)
												19.3040	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1457.6039 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	340.8672	224.5699	133.0616	35.8804	5.5252	0.0000	0.0000	0.0000	0.0000	57.0557	209.4550	356.4448	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	364.5639	240.1817	142.3119	38.3747	5.9093	0.0000	0.0000	0.0000	0.0000	61.0221	224.0160	381.2244	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	173.8930	152.9614	159.9165	142.3467	138.7652	122.9430	117.0760	129.8440	130.0457	147.6547	157.3969	169.3691	(64)
Efficiency of water heater (217)m	86.5784	85.8368	84.3282	81.7457	80.1629	79.8000	79.8000	79.8000	79.8000	82.5193	85.5769	86.7531	(216)
Fuel for water heating, kWh/month	200.8504	178.2003	189.6359	174.1335	173.1039	154.0640	146.7118	162.7118	162.9645	178.9336	183.9246	195.2311	(219)
Water heating fuel used												2100.4655	(219)
Annual totals kWh/year													
Space heating fuel - main system												1457.6039	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												312.8287	(232)
Total delivered energy for all uses												3945.8981	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1457.6039	0.2160	314.8425 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2100.4655	0.2160	453.7005 (264)
Space and water heating			768.5430 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	312.8287	0.5190	162.3581 (268)
Total CO2, kg/m2/year			969.8261 (272)
Emissions per m2 for space and water heating			10.8859 (272a)
Fuel factor (electricity)			1.5500
Emissions per m2 for lighting			2.2997 (272b)
Emissions per m2 for pumps and fans			0.5513 (272c)
Target Carbon Dioxide Emission Rate (TER) = (10.8859 * 1.55) + 2.2997 + 0.5513, rounded to 2 d.p.			19.7200 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) =	0.1700 (8)
Pressure test					Yes
Measured/design AP50					3.0000
Infiltration rate					0.3200 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2720 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.3468	0.3400	0.3332	0.2992	0.2924	0.2584	0.2584	0.2516	0.2720	0.2924	0.3060	0.3196 (22b)
	0.5601	0.5578	0.5555	0.5448	0.5427	0.5334	0.5334	0.5316	0.5370	0.5427	0.5468	0.5511 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
windows (Uw = 1.20)			18.7500	1.1450	21.4695			(27)
External Wall 1	46.2500	18.7500	27.5000	0.1500	4.1250	70.0000	1925.0000	(29a)
Total net area of external elements Aum(A, m2)			46.2500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...	(30) + (32) =	25.5945			(33)
Party Wall hall			13.7500	0.0000	0.0000	180.0000	2475.0000	(32)
Party Wall flat			32.5000	0.0000	0.0000	110.0000	3575.0000	(32)
Party Floor 1			70.6000			40.0000	2824.0000	(32d)
Party Ceilings 1			70.6000			30.0000	2118.0000	(32b)
Internal Wall 1			165.3000			9.0000	1487.7000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...	(30) + (32) + (32a)...	(32e) =	14404.7000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								204.0326 (35)
Thermal bridges (User defined value 0.075 * total exposed area)								3.4688 (36)
Total fabric heat loss						(33) + (36) =		29.0632 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	32.6244	32.4885	32.3552	31.7291	31.6120	31.0667	31.0667	30.9657	31.2767	31.6120	31.8489	32.0967 (38)
Heat transfer coeff	61.6877	61.5517	61.4184	60.7923	60.6752	60.1299	60.1299	60.0289	60.3399	60.6752	60.9121	61.1599 (39)
Average = Sum(39)m / 12 =												60.7918 (39)
HLP	0.8738	0.8718	0.8699	0.8611	0.8594	0.8517	0.8517	0.8503	0.8547	0.8594	0.8628	0.8663 (40)
HLP (average)												0.8611 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
Daily hot water use	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy conte	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Energy content (annual)										Total = Sum(45)m =		1382.8412 (45)
Distribution loss (46)m = 0.15 x (45)m												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	30.4663	26.6461	27.4964	23.9720	23.0017	19.8487	18.3927	21.1059	21.3580	24.8907	27.1702	29.5050 (65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	(71)
Water heating gains (Table 5)	40.9494	39.6519	36.9575	33.2944	30.9163	27.5677	24.7214	28.3682	29.6639	33.4553	37.7363	39.6573	(72)
Total internal gains	314.2654	313.0492	302.2210	284.3885	265.6020	248.0027	236.8820	240.4475	249.8770	267.8377	288.5271	304.6988	(73)

6. Solar gains

[Jan]																				
				Area m2			Solar flux Table 6a W/m2			g Specific data or Table 6b			FF Specific data or Table 6c			Access factor Table 6d			Gains W	
South				4.0000			46.7521			0.6000			0.7000			0.7700			54.4306	(78)
West				14.7500			19.6403			0.6000			0.7000			0.7700			84.3183	(80)
Solar gains	138.7489	254.0878	385.1929	524.5102	619.2598	625.7226	598.9336	528.5786	434.5480	291.8700	169.6539	116.3723	(83)							
Total gains	453.0144	567.1370	687.4139	808.8987	884.8618	873.7253	835.8156	769.0260	684.4249	559.7077	458.1810	421.0711	(84)							

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	64.8639	65.0073	65.1483	65.8193	65.9463	66.5444	66.5444	66.6563	66.3127	65.9463	65.6898	65.4237	
alpha	5.3243	5.3338	5.3432	5.3880	5.3964	5.4363	5.4363	5.4438	5.4208	5.3964	5.3793	5.3616	
util living area	0.9929	0.9776	0.9291	0.8008	0.6161	0.4376	0.3161	0.3582	0.5915	0.8895	0.9828	0.9950	(86)
MIT	20.0401	20.2776	20.5830	20.8543	20.9683	20.9958	20.9994	20.9989	20.9809	20.7791	20.3428	19.9919	(87)
Th 2	20.1899	20.1915	20.1931	20.2007	20.2021	20.2088	20.2088	20.2100	20.2062	20.2021	20.1993	20.1963	(88)
util rest of house	0.9911	0.9722	0.9139	0.7673	0.5693	0.3847	0.2595	0.2971	0.5295	0.8601	0.9778	0.9938	(89)
MIT 2	19.3113	19.5465	19.8409	20.0908	20.1821	20.2068	20.2086	20.2096	20.1962	20.0342	19.6191	19.2687	(90)
Living area fraction	19.5033	19.7391	20.0364	20.2919	20.3892	20.4147	20.4169	20.4176	20.4029	20.2304	19.8098	19.4592	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5033	19.7391	20.0364	20.2919	20.3892	20.4147	20.4169	20.4176	20.4029	20.2304	19.8098	19.4592	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	448.1012	549.3423	625.9078	623.9690	513.6952	348.1886	229.3636	240.8690	373.1615	482.0396	446.6461	417.8102	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	937.8561	913.3724	831.3829	692.5415	527.2196	349.6358	229.5115	241.1693	380.3173	584.3279	774.1810	933.2535	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	364.3776	244.6282	152.8735	49.3722	10.0621	0.0000	0.0000	0.0000	0.0000	76.1025	235.8251	383.4898	(98)
Space heating												1516.7311	(98)
Space heating per m2										(98) / (4) =		21.4834	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	565.2210	444.9612	456.2198	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9871	0.9948	0.9917	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	557.9125	442.6399	452.4389	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1105.1954	1059.1833	982.4709	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	394.0437	458.7083	394.3438	0.0000	0.0000	0.0000	0.0000	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												1247.0958 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)	
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	98.5109	114.6771	98.5860	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												311.7739 (107)
Space cooling per m2												4.4161 (108)
Energy for space heating												21.4834 (99)
Energy for space cooling												4.4161 (108)
Total												25.8995 (109)
Dwelling Fabric Energy Efficiency (DFEE)												25.9 (109)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	70.6000 (1b)	x 2.5000 (2b)	= 176.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.6000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 176.5000 (5)

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)
								Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						30.0000 / (5) =	0.1700	(8)
Pressure test							Yes		
Measured/design AP50								5.0000	
Infiltration rate								0.4200	(18)
Number of sides sheltered								2	(19)
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.3570	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
	0.4551	0.4462	0.4373	0.3927	0.3837	0.3391	0.3391	0.3302	0.3570	0.3837	0.4016	0.4194 (22b)
Effective ac	0.6036	0.5996	0.5956	0.5771	0.5736	0.5575	0.5575	0.5545	0.5637	0.5736	0.5806	0.5880 (25)

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opening Type (Uw = 1.40)			17.6700	1.3258	23.4261			(27)					
External Wall 1	46.2500	17.6700	28.5800	0.1800	5.1444			(29a)					
Total net area of external elements Aum(A, m2)			46.2500					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	28.5705			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								0.0000 (36)					
Total fabric heat loss						(33) + (36) =	28.5705	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.1554	34.9211	34.6915	33.6130	33.4112	32.4718	32.4718	32.2978	32.8336	33.4112	33.8194	34.2462	(38)
Heat transfer coeff	63.7259	63.4917	63.2621	62.1835	61.9817	61.0423	61.0423	60.8684	61.4042	61.9817	62.3899	62.8167	(39)
Average = Sum(39)m / 12 =												62.1825	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9026	0.8993	0.8961	0.8808	0.8779	0.8646	0.8646	0.8622	0.8697	0.8779	0.8837	0.8898	(40)
HLP (average)												0.8808	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

Assumed occupancy												2.2606 (42)
Average daily hot water use (litres/day)												87.8893 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	96.6783	93.1627	89.6471	86.1315	82.6160	79.1004	79.1004	82.6160	86.1315	89.6471	93.1627	96.6783 (44)
Energy content (annual)	143.3711	125.3932	129.3946	112.8093	108.2432	93.4057	86.5541	99.3221	100.5083	117.1328	127.8596	138.8472 (45)
Distribution loss (46)m = 0.15 x (45)m	Total = Sum(45)m =											1382.8412 (45)
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.4663	26.6461	27.4964	23.9720	23.0017	19.8487	18.3927	21.1059	21.3580	24.8907	27.1702	29.5050 (65)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	113.0301	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.7137	15.7331	12.7950	9.6867	7.2409	6.1131	6.6054	8.5859	11.5240	14.6324	17.0781	18.2060	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.6934	200.7552	195.5595	184.4984	170.5358	157.4130	148.6461	146.5843	151.7800	162.8410	176.8036	189.9265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	34.3030	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	-90.4241	(71)
Water heating gains (Table 5)	40.9494	39.6519	36.9575	33.2944	30.9163	27.5677	24.7214	28.3682	29.6639	33.4553	37.7363	39.6573	(72)
Total internal gains	314.2654	313.0492	302.2210	284.3885	265.6020	248.0027	236.8820	240.4475	249.8770	267.8377	288.5271	304.6988	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c	Access factor Table 6d		Gains W	
South					3.7700	46.7521	0.6300		0.7000	0.7700		53.8659	
West					13.9000	19.6403	0.6300		0.7000	0.7700		83.4322 (80)	
Solar gains	137.2982	251.4296	381.1602	519.0155	612.7701	619.1644	592.6565	523.0403	429.9974	288.8157	167.8797	115.1557	(83)
Total gains	451.5636	564.4789	683.3812	803.4040	878.3722	867.1671	829.5385	763.4878	679.8743	556.6534	456.4068	419.8545	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.0000 (85)
tau	76.9353	77.2192	77.4995	78.8437	79.1004	80.3177	80.3177	80.5472	79.8444	79.1004	78.5828	78.0489	
alpha	6.1290	6.1479	6.1666	6.2562	6.2734	6.3545	6.3545	6.3698	6.3230	6.2734	6.2389	6.2033	
util living area	0.9970	0.9882	0.9528	0.8324	0.6394	0.4489	0.3236	0.3663	0.6110	0.9171	0.9913	0.9980	(86)
MIT	20.1447	20.3527	20.6287	20.8829	20.9793	20.9981	20.9998	20.9996	20.9884	20.8123	20.4201	20.1114	(87)
Th 2	20.1653	20.1681	20.1708	20.1839	20.1863	20.1977	20.1977	20.1998	20.1933	20.1863	20.1814	20.1762	(88)
util rest of house	0.9960	0.9846	0.9397	0.7976	0.5890	0.3934	0.2647	0.3028	0.5446	0.8890	0.9881	0.9974	(89)
MIT 2	19.3834	19.5916	19.8603	20.0987	20.1742	20.1969	20.1976	20.1997	20.1878	20.0473	19.6708	19.3595	(90)
Living area fraction	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(91)
MIT	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(92)
Temperature adjustment	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(93)
adjusted MIT	19.5840	19.7921	20.0628	20.3053	20.3863	20.4080	20.4090	20.4104	20.3987	20.2488	19.8682	19.5576	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9827	0.9378	0.8031	0.6016	0.4080	0.2802	0.3196	0.5618	0.8914	0.9865	0.9968	(94)
Useful gains	449.3762	554.6914	640.8741	645.2126	528.4413	353.8185	232.4564	243.9910	381.9811	496.2157	450.2624	418.4905	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	973.9856	945.5245	858.0078	709.2221	538.3909	354.5323	232.5081	244.1073	386.7685	598.0518	796.6090	964.7165	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	390.3094	262.6399	161.5475	46.0869	7.4025	0.0000	0.0000	0.0000	0.0000	75.7661	249.3695	406.3922	(98)
Space heating												1599.5139	(98)
Space heating per m ²												22.6560	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	573.7979	451.7133	462.5996	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9922	0.9973	0.9955	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	569.3171	450.5128	460.4977	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1097.5299	1051.8464	975.9976	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	380.3132	447.3922	383.5319	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1211.2374	(104)
Cooled fraction												1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	95.0783	111.8481	95.8830	0.0000	0.0000	0.0000	0.0000	(107)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling	302.8093 (107)
Space cooling per m2	4.2891 (108)
Energy for space heating	22.6560 (99)
Energy for space cooling	4.2891 (108)
Total	26.9451 (109)
Target Fabric Energy Efficiency (TFEE)	31.0 (109)

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Reference	000091	Issued on Date	26/11/2021
Block Name	Block A		
Assessor Details	Mr. William O'Reilly, Synergy Consulting Engineers Limited, Tel: 02075298950, william.oreilly@synconsult.co.uk		Assessor ID
			H824-0001
Client			

Block Compliance Report - DER

Block Reference: 000091		Block Name: Block A			
Property-Assessment Reference	Multiplier	Floor Area (m ²)	DER (kgCO ₂ /m ²)	TER (kgCO ₂ /m ²)	% DER/TER
Avondale A.00.001-Avondale A.00.001	1	92.3	12.86	15.01	14.35 %
Avondale A.00.003-Avondale A.00.003	1	128.1	11.65	13.29	12.34 %
Avondale A.00.004-Avondale A.00.004	1	85.8	10.27	12.45	17.53 %
Avondale A.01.003-Avondale A.01.003	3	72	10.69	13.57	21.24 %
Avondale A.01.002-Avondale A.01.002	3	70	12.45	14.79	15.85 %
Avondale A.02.004-Avondale A.02.004	2	73.1	11.86	14.70	19.31 %
Avondale A.02.007-Avondale A.02.007	2	70.6	11.61	14.28	18.69 %
Avondale A.04.005-design default acd	2	51.1	13.20	15.54	15.07 %
Avondale A.00.002-Avondale A.00.002	1	77.3	11.69	16.03	27.09 %
Avondale A.00.005-Avondale A.00.005	1	128.1	11.21	12.91	13.20 %
Avondale A.01.001-Avondale A.01.001	3	92.3	10.76	13.44	19.97 %
Avondale A.01.004-Avondale A.01.004	5	51.1	11.95	14.24	16.06 %
Avondale A.04.001-Avondale A.04.001	1	92.3	12.95	15.01	13.75 %
Avondale A.04.002-Avondale A.04.002	1	70	14.59	16.34	10.73 %
Avondale A.04.003-Avondale A.04.003	1	72	12.60	15.12	16.68 %
Avondale A.04.004-Avondale A.04.004	1	73.1	14.10	16.31	13.53 %
Avondale A.04.007-Avondale A.04.007	1	70.6	13.61	15.75	13.60 %
Totals:	30	2237.6	208.05	248.81	
Average DER = 11.93 kgCO ₂ /m ²		% DER/TER	PASS		
Average TER = 14.36 kgCO ₂ /m ²		16.92 %			

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Compliance Report - DFEE

Block Reference: 000091		Block Name: Block A			
Property-Assessment Reference	Multiplier	Floor Area (m ²)	DFEE (kWh/m ² /yr)	TFEE (kWh/m ² /yr)	% DFEE/TFEE
Avondale A.00.001-Avondale A.00.001	1	92.3	37.48	41.64	9.98 %
Avondale A.00.003-Avondale A.00.003	1	128.1	37.48	40.96	8.48 %
Avondale A.00.004-Avondale A.00.004	1	85.8	22.20	25.80	13.96 %
Avondale A.01.003-Avondale A.01.003	3	72	20.32	25.60	20.65 %
Avondale A.01.002-Avondale A.01.002	3	70	29.41	33.14	11.24 %
Avondale A.02.004-Avondale A.02.004	2	73.1	27.58	33.00	16.41 %
Avondale A.02.007-Avondale A.02.007	2	70.6	25.90	30.99	16.42 %
Avondale A.04.005-design default acd	2	51.1	24.69	26.59	7.14 %
Avondale A.00.002-Avondale A.00.002	1	77.3	28.65	42.13	31.99 %
Avondale A.00.005-Avondale A.00.005	1	128.1	35.46	39.36	9.91 %
Avondale A.01.001-Avondale A.01.001	3	92.3	27.64	33.66	17.89 %
Avondale A.01.004-Avondale A.01.004	5	51.1	12.54	15.99	21.53 %
Avondale A.04.001-Avondale A.04.001	1	92.3	37.36	41.64	10.28 %
Avondale A.04.002-Avondale A.04.002	1	70	38.76	41.15	5.82 %
Avondale A.04.003-Avondale A.04.003	1	72	31.67	35.24	10.13 %
Avondale A.04.004-Avondale A.04.004	1	73.1	37.70	41.29	8.70 %
Avondale A.04.007-Avondale A.04.007	1	70.6	35.33	38.62	8.53 %
Totals:	30	2237.6	510.18	586.80	
Average DFEE = 27.82 kWh/m ² /yr		% DFEE/TFEE	PASS		
Average TFEE = 32.37 kWh/m ² /yr		14.06 %			

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Reference	000092	Issued on Date	05/11/2021
Block Name	Block A		
Assessor Details	Mr. William O'Reilly, Synergy Consulting Engineers Limited, Tel: 02075298950, william.oreilly@synconsult.co.uk		Assessor ID
			H824-0001
Client			

Block Compliance Report - DER

Block Reference: 000092		Block Name: Block A			
Property-Assessment Reference	Multiplier	Floor Area (m ²)	DER (kgCO ₂ /m ²)	TER (kgCO ₂ /m ²)	% DER/TER
Avondale A.00.001-Avondale A.00.001	1	92.3	8.75	21.27	58.86 %
Avondale A.00.002-Avondale A.00.002	1	77.3	7.65	22.63	66.20 %
Avondale A.00.003-Avondale A.00.003	1	128.1	8.23	18.98	56.63 %
Avondale A.00.004-Avondale A.00.004	1	85.8	6.68	17.12	60.99 %
Avondale A.00.005-Avondale A.00.005	1	128.1	7.90	18.39	57.03 %
Avondale A.01.001-Avondale A.01.001	3	92.3	7.17	18.82	61.89 %
Avondale A.01.002-Avondale A.01.002	3	70	8.08	20.55	60.68 %
Avondale A.01.003-Avondale A.01.003	3	72	6.77	18.66	63.72 %
Avondale A.01.004-Avondale A.01.004	5	51.1	7.07	19.04	62.86 %
Avondale A.02.004-Avondale A.02.004	2	73.1	7.69	20.45	62.40 %
Avondale A.02.007-Avondale A.02.007	2	70.6	7.44	19.72	62.28 %
Avondale A.04.001-Avondale A.04.001	1	92.3	8.84	21.27	58.44 %
Avondale A.04.002-Avondale A.04.002	1	70	9.73	22.98	57.66 %
Avondale A.04.003-Avondale A.04.003	1	72	8.24	21.10	60.95 %
Avondale A.04.004-Avondale A.04.004	1	73.1	9.40	22.98	59.09 %
Avondale A.04.005-design default acd	2	51.1	8.07	21.13	61.81 %
Avondale A.04.007-Avondale A.04.007	1	70.6	8.97	22.04	59.30 %
Totals:	30	2237.6	136.68	347.11	
Average DER = 7.78 kgCO ₂ /m ²		% DER/TER	PASS		
Average TER = 19.95 kgCO ₂ /m ²		61.00 %			

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Compliance Report - DFEE

Block Reference: 000092		Block Name: Block A			
Property-Assessment Reference	Multiplier	Floor Area (m²)	DFEE (kWh/m²/yr)	TFEE (kWh/m²/yr)	% DFEE/TFEE
Avondale A.00.001-Avondale A.00.001	1	92.3	37.48	41.64	9.98 %
Avondale A.00.002-Avondale A.00.002	1	77.3	28.65	42.13	31.99 %
Avondale A.00.003-Avondale A.00.003	1	128.1	37.48	40.96	8.48 %
Avondale A.00.004-Avondale A.00.004	1	85.8	22.20	25.80	13.96 %
Avondale A.00.005-Avondale A.00.005	1	128.1	35.46	39.36	9.91 %
Avondale A.01.001-Avondale A.01.001	3	92.3	27.64	33.66	17.89 %
Avondale A.01.002-Avondale A.01.002	3	70	29.41	33.14	11.24 %
Avondale A.01.003-Avondale A.01.003	3	72	20.32	25.60	20.65 %
Avondale A.01.004-Avondale A.01.004	5	51.1	12.54	15.99	21.53 %
Avondale A.02.004-Avondale A.02.004	2	73.1	27.58	33.00	16.41 %
Avondale A.02.007-Avondale A.02.007	2	70.6	25.90	30.99	16.42 %
Avondale A.04.001-Avondale A.04.001	1	92.3	37.36	41.64	10.28 %
Avondale A.04.002-Avondale A.04.002	1	70	38.76	41.15	5.82 %
Avondale A.04.003-Avondale A.04.003	1	72	31.67	35.24	10.13 %
Avondale A.04.004-Avondale A.04.004	1	73.1	37.70	41.29	8.70 %
Avondale A.04.005-design default acd	2	51.1	24.69	26.59	7.14 %
Avondale A.04.007-Avondale A.04.007	1	70.6	35.33	38.62	8.53 %
Totals:	30	2237.6	510.18	586.80	
Average DFEE = 27.82 kWh/m²/yr		% DFEE/TFEE	PASS		
Average TFEE = 32.37 kWh/m²/yr		14.06 %			

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Reference	000092	Issued on Date	25/11/2021
Block Name	Block A		
Assessor Details	Mr. William O'Reilly, Synergy Consulting Engineers Limited, Tel: 02075298950, william.oreilly@synconsult.co.uk		Assessor ID
			H824-0001
Client			

Block Compliance Report - DER

Block Reference: 000092		Block Name: Block A			
Property-Assessment Reference	Multiplier	Floor Area (m ²)	DER (kgCO ₂ /m ²)	TER (kgCO ₂ /m ²)	% DER/TER
Avondale A.00.003-Avondale A.00.003	1	128.1	3.68	18.98	80.61 %
Avondale A.00.001-Avondale A.00.001	1	92.3	2.44	21.27	88.53 %
Avondale A.00.004-Avondale A.00.004	1	85.8	-0.11	17.12	100.64 %
Avondale A.01.003-Avondale A.01.003	3	72	-1.32	18.66	107.07 %
Avondale A.01.002-Avondale A.01.002	3	70	-0.25	20.55	101.22 %
Avondale A.02.007-Avondale A.02.007	2	70.6	-0.82	19.72	104.16 %
Avondale A.04.005-design default acd	2	51.1	-3.33	21.13	115.76 %
Avondale A.02.004-Avondale A.02.004	2	73.1	-0.28	20.45	101.37 %
Avondale A.00.002-Avondale A.00.002	1	77.3	0.11	22.63	99.51 %
Avondale A.00.005-Avondale A.00.005	1	128.1	3.35	18.39	81.78 %
Avondale A.01.001-Avondale A.01.001	3	92.3	0.86	18.82	95.43 %
Avondale A.01.004-Avondale A.01.004	5	51.1	-4.33	19.04	122.75 %
Avondale A.04.001-Avondale A.04.001	1	92.3	2.52	21.27	88.15 %
Avondale A.04.002-Avondale A.04.002	1	70	1.41	22.98	93.86 %
Avondale A.04.003-Avondale A.04.003	1	72	0.15	21.10	99.29 %
Avondale A.04.004-Avondale A.04.004	1	73.1	1.43	22.98	93.78 %
Avondale A.04.007-Avondale A.04.007	1	70.6	0.72	22.04	96.73 %
Totals:	30	2237.6	6.23	347.11	
Average DER = -0.04 kgCO ₂ /m ²		% DER/TER	PASS		
Average TER = 19.95 kgCO ₂ /m ²		100.20 %			

BLOCK COMPLIANCE

Calculation Type: New Build (As Designed)

Block Compliance Report - DFEE

Block Reference: 000092		Block Name: Block A			
Property-Assessment Reference	Multiplier	Floor Area (m ²)	DFEE (kWh/m ² /yr)	TFEE (kWh/m ² /yr)	% DFEE/TFEE
Avondale A.00.003-Avondale A.00.003	1	128.1	37.48	40.96	8.48 %
Avondale A.00.001-Avondale A.00.001	1	92.3	37.48	41.64	9.98 %
Avondale A.00.004-Avondale A.00.004	1	85.8	22.20	25.80	13.96 %
Avondale A.01.003-Avondale A.01.003	3	72	20.32	25.60	20.65 %
Avondale A.01.002-Avondale A.01.002	3	70	29.41	33.14	11.24 %
Avondale A.02.007-Avondale A.02.007	2	70.6	25.90	30.99	16.42 %
Avondale A.04.005-design default acd	2	51.1	24.69	26.59	7.14 %
Avondale A.02.004-Avondale A.02.004	2	73.1	27.58	33.00	16.41 %
Avondale A.00.002-Avondale A.00.002	1	77.3	28.65	42.13	31.99 %
Avondale A.00.005-Avondale A.00.005	1	128.1	35.46	39.36	9.91 %
Avondale A.01.001-Avondale A.01.001	3	92.3	27.64	33.66	17.89 %
Avondale A.01.004-Avondale A.01.004	5	51.1	12.54	15.99	21.53 %
Avondale A.04.001-Avondale A.04.001	1	92.3	37.36	41.64	10.28 %
Avondale A.04.002-Avondale A.04.002	1	70	38.76	41.15	5.82 %
Avondale A.04.003-Avondale A.04.003	1	72	31.67	35.24	10.13 %
Avondale A.04.004-Avondale A.04.004	1	73.1	37.70	41.29	8.70 %
Avondale A.04.007-Avondale A.04.007	1	70.6	35.33	38.62	8.53 %
Totals:	30	2237.6	510.18	586.80	
Average DFEE = 27.82 kWh/m ² /yr		% DFEE/TFEE	PASS		
Average TFEE = 32.37 kWh/m ² /yr		14.06 %			

MAYOR OF LONDON

OVERALL PROGRESS

94%

CURRENT REPORTING STAGE

----->>

Planning

*

CONTEXTUAL DATA

Progress: 89%

+ ORGANISATION & CONTACT DETAILS

ORGANISATION DETAILS

Organisation Name

Synergy Consulting Engineers

*

Organisation Address

anal Side Studios, 8-14 St Pancras Way, London NW1

*

CONTACT DETAILS

Contact Name

James Grace

*

Email

jim.grace@synconsult.co.uk

*

Additional Email(s)

*

Telephone No.

2075298950

*

Mobile No.

7950216654

*

+ DEVELOPMENT INFORMATION

OVERALL DEVELOPMENT DETAILS

Planning Reference Number

Must complete ->

*

Name of Whole Development

Avondale Drive Estate

*

DEVELOPMENT LOCATION

Development Address

Address Line 1

Block 1a

*

Address Line 2

Avondale Drive Estate

Address Line 3

Avondale Drive

Address Line 4

London Borough

Hillingdon

*

Postcode

UB3 PE

*

Ordnance Survey Reference

Development UPRN (if available)

N/A

Geo-Location Coordinates

Latitude (to 6 decimal places)

Please add if available ->

Longitude (to 6 decimal places, +ve or -ve)

Please add if available ->

DEVELOPMENT TOTAL AREA BREAKDOWN

Residential

Total Residential Floor Area

GIA m2

2,238

*

Dwelling Counts

Flats

number

30

*

House

number

0

*

Non-Residential

Non-Residential Floor Area Breakdown

Please include complete non-resi details below

Landlord Circulation (in Residential Blocks)

GIA m2

0

*

General office (A2, B1, B8, D1 planning classes)

GIA m2

0

*

High street agency (A2 planning classes)

GIA m2

0

*

General retail (A1, SG planning classes)

GIA m2

0

*

Large non-food shop (A1 planning classes)

GIA m2

0

*

Small food store

GIA m2

0

*

Large food store

GIA m2

0

*

Restaurant (A3, A5 planning classes)

GIA m2

0

*

Bar, pub or licensed club (A4 planning classes)

GIA m2

0

*

Hotel (C1 planning classes)

GIA m2

0

*

Cultural Activities

GIA m2

0

*

Entertainment halls (D2 planning classes)

GIA m2

0

*

Swimming pool centre

GIA m2

0

*

Fitness and health centre

GIA m2

0

*

Dry sports and leisure facility (D2 planning classes)

GIA m2

0

*

Covered car park

GIA m2

0

*

Public buildings with light usage (D1, SG planning classes)

GIA m2

0

*

Schools and seasonal public buildings (D1, D2 planning cla

GIA m2

0

*

University campus

GIA m2

0

*

Clinic (D1 planning classes)

GIA m2

0

*

Hospital (clinical and research)

GIA m2

0

*

Long term residential (C1, C2, C2A planning classes)

GIA m2

0

*

General accommodation (C1, C2, C3 planning classes)

GIA m2

0

*

Emergency services (SG planning classes)

GIA m2

0

*

Laboratory or operating theatre

GIA m2

0

*

Public waiting or circulation (SG planning classes)

GIA m2

0

*

Terminal (B8 planning classes)

GIA m2

0

*

Workshop (B1, B2 planning classes)

GIA m2

0

*

Storage Facility (B8 planning classes)

GIA m2

0

*

Cold Storage (B8 planning classes)

GIA m2

0

*

Overall Development Summary

Total Development Floor Area

Residential	GIA m2
Non-Residential	GIA m2
Total	GIA m2
Total Non-Residential Uses	

2,238

0

2,238

There is no non-domestic floor area.

+ SUPPLEMENTARY FILES AND UPCOMING REPORTING STAGES

SUPPLEMENTARY FILES

Site Plan

Does the development have a site plan?

Yes

*

What is the site plan filename?

Must complete ->

*

Best Practice Documents

Does the development have a predicted DEC?

No

*

ANTICIPATED DATES FOR UPCOMING REPORTING STAGES

As-Built Stage

1 Jun 2024

*

Operational Year 1 End

1 Jun 2025

*

DEVELOPMENT PERFORMANCE AND EMISSIONS

Progress: 100%

+ DEVELOPMENT PERFORMANCE

DEVELOPMENT OVERALL PREDICTED PERFORMANCE

Predicted Performance Calculation Details

Fuel Carbon Intensity Source (aligned with planning energy statement)

SAP 10.0

*

Residential Elements of the development

Predicted Annual Energy Use

Fill in all applicable fuels below

Annual Electricity Use	kWh/yr
Annual Gas Use	kWh/yr
Annual Oil Use (if applicable)	kWh/yr
Annual Biomass Use (if applicable)	kWh/yr
Annual District Htg Use (if applicable)	kWh/yr
Annual District Clg Use (if applicable)	kWh/yr
Elec Generation, Gross (if applicable)	kWh/yr
Solar Thermal Generation (if applicable)	kWh/yr
Predicted Annual Carbon Emissions	tCO2/yr

32,754

0

0

0

0

0

0

33,681

0

0

Non-Residential Elements of the development (Part L Calculation)

Predicted Annual Energy Use

Fill in all applicable fuels below

Annual Electricity Use	kWh/yr
Annual Gas Use	kWh/yr
Annual Oil Use (if applicable)	kWh/yr
Annual Biomass Use (if applicable)	kWh/yr
Annual District Htg Use (if applicable)	kWh/yr
Annual District Clg Use (if applicable)	kWh/yr
Elec Generation, Gross (if applicable)	kWh/yr
Solar Thermal Generation (if applicable)	kWh/yr
Predicted Annual Carbon Emissions	tCO2/yr

0

0

0

0

0

0

0

0

0

Non-Residential Elements of the development (TM54 Calculation)

Predicted Annual Energy Use

Fill in all applicable fuels below

Annual Electricity Use	kWh/yr
Annual Gas Use	kWh/yr
Annual Oil Use (if applicable)	kWh/yr
Annual Biomass Use (if applicable)	kWh/yr
Annual District Htg Use (if applicable)	kWh/yr
Annual District Clg Use (if applicable)	kWh/yr
Elec Generation, Gross (if applicable)	kWh/yr
Solar Thermal Generation (if applicable)	kWh/yr
Predicted Annual Carbon Emissions	tCO2/yr

0

0

0

0

0

0

0

0

0

CARBON OFFSETTING

Predicted Carbon Shortfall (aligned with planning energy state tCO2

0

*

Total Committed Carbon Offset

£

0

*

END

Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

APPENDIX D - ENERGY MODELLING

A communal heating strategy is proposed:

Domestic Hot Water: Communal Air Source Heat Pump system, with communal hot water storage.

Space Heating: Communal Brine Water Heat Pump coupled to external Air Collector (ie effectively air source) heating the apartments via an LPHW heating coil in each apartment's MVHR supply duct and secondary heating via electric towel rails in bathrooms and electrical panel heaters in habitable rooms. The secondary heating is intended to be less than 10% of overall space heating which is, itself, less than 30% of overall Heat for Domestic Hot Water and Space Heating.

D1. Estimation of Space Heating Energy.

The first step is to determine how much heat the LPHW battery in each MVHR unit can deliver. This is a function of (a) the air supply temperature, and (b) the air volume flowrate, which is determined by Building Regulations Part F.

- Supply temperature. In the classic Passivhaus concept, air is supplied at up to 50 deg C using an electrical heating element. Our proposal instead uses LPHW from a Heat Pump, and there is a considerable energy benefit to using the lowest LPHW temperatures possible; in this case 40deg C, which limits the maximum air supply temperature to 33 deg C.
- Volume flowrate. Building Regulations Part F sets a minimum flowrate based upon either area of apartment times 0.3l/s per m² OR number of bedrooms (9l/s plus 4l/s for each bedroom) whichever is the highest figure. The resulting flowrates were as follows:

	GIA	x 0.3l/s	Beds	9+4xbeds	Max
Avondale A.00.001 3b5p	92.3	27.69	3	21	27.69
Avondale A.00.002 2b3p	77.3	23.19	2	17	23.19
Avondale A.00.003 4b7p	128.1	38.43	4	25	38.43
Avondale A.00.004 2b4p	85.8	25.74	2	17	25.74
Avondale A.00.005 4b7p	128.1	38.43	4	25	38.43
Avondale A.01.001 3b5p	92.3	27.69	3	21	27.69
Avondale A.01.002 2b4p	70	21	2	17	21
Avondale A.01.003 2b4p	72	21.6	2	17	21.6
Avondale A.01.004 1b2p	51.1	15.33	1	13	15.33
Avondale A.02.004 2b4p	73.1	21.93	2	17	21.93
Avondale A.02.007 2b4p	70.6	21.18	2	17	21.18
Avondale A.04.001 3b5p	92.3	27.69	3	21	27.69
Avondale A.04.002 2b4p	70	21	2	17	21
Avondale A.04.003 2b4p	72	21.6	2	17	21.6
Avondale A.04.004 2b4p	73.1	21.93	2	17	21.93
Avondale A.04.005 1b2p	51.1	15.33	1	13	15.33
Avondale A.04.007 2b4p	70.6	21.18	2	17	21.18

Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

The SAP Calculations provide an overall figure for annual heat loss (Row 98) for each apartment, but a finer level of detail is required in order to calculate exactly how much comes from the Heat Pump and how much comes from the Secondary Heating.

The London TRY05.fwt weather file was used to calculate how many hours per year each outside temperature occurs and the associated net heat loss rate. This was then used to calculate how many kWh of heat come from the MVHR heater coil (ie from the Heat Pump) and how many from the Secondary heating. The results for a typical apartment are shown below. The mean internal temperature of the apartment comes from the SAP calculations; as is the figure for useful gains (Internal and solar).

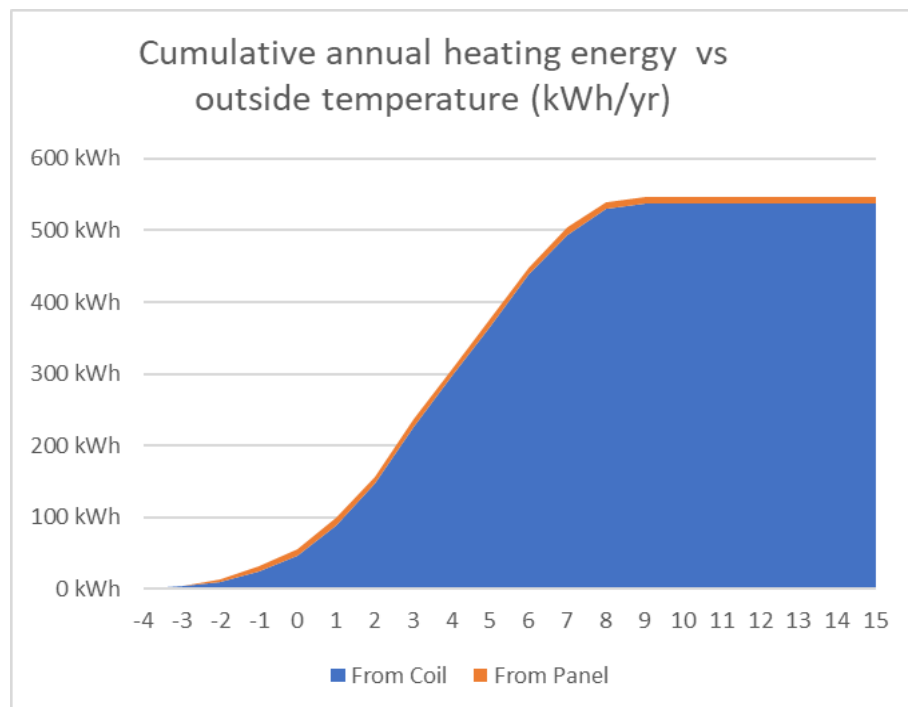
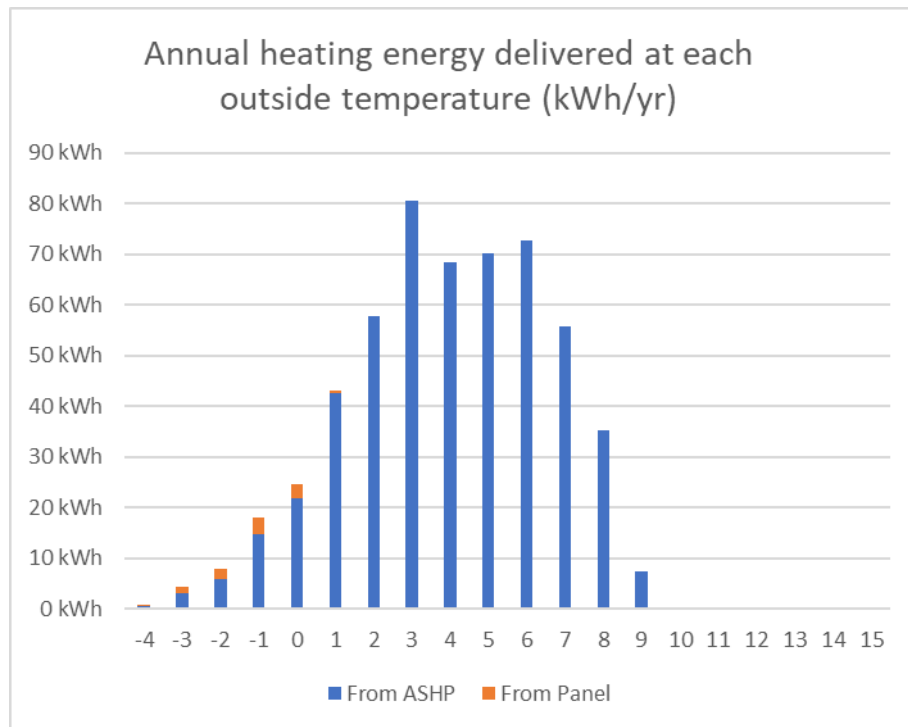
		Reference	Avondale A.02.007		
		AREA	70.6		
		MIT	20.1	(Row 93)	
		Useful Gains	547.1	(Row 95)	
		Supply Air l/s	21.2	Part F	
		MVHR Eff.	85%		
Outside Temperature	*hrs/yr	Net Heat loss rate	From ASHP	From Panel	
-4	1	667 W	0 kWh	0 kWh	
-3	7	617 W	3 kWh	1 kWh	
-2	14	566 W	6 kWh	2 kWh	
-1	35	516 W	15 kWh	3 kWh	
0	53	466 W	22 kWh	3 kWh	
1	104	415 W	43 kWh	1 kWh	
2	158	365 W	58 kWh	0 kWh	
3	256	315 W	81 kWh	0 kWh	
4	259	264 W	68 kWh	0 kWh	
5	328	214 W	70 kWh	0 kWh	
6	444	164 W	73 kWh	0 kWh	
7	492	113 W	56 kWh	0 kWh	
8	558	63 W	35 kWh	0 kWh	
9	582	13 W	7 kWh	0 kWh	
10	499	0 W	0 kWh	0 kWh	
11	459	0 W	0 kWh	0 kWh	
12	474	0 W	0 kWh	0 kWh	
13	600	0 W	0 kWh	0 kWh	
14	540	0 W	0 kWh	0 kWh	
15	506	0 W	0 kWh	0 kWh	
* weather file: LondonTRY05.fwt			537 kWh	10 kWh	
			98.1%	1.9%	

The results and cumulative totals are shown on the next page.

Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021



Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

Repeating the calculation for each apartment and multiplying by their number in the scheme gives the following collected totals:

		Heat From HP (kWh)	Heat from secondary (kWh)	Total for all Apartments (kWh)	Total Coil outputs (W)	£0.035 Heat from ASHP (£)	£0.180 Heat from secondary (£)
	No.off						
Avondale A.00.001	1	1587	191	1778	571	56	34
Avondale A.00.002	1	774	14	788	472	27	3
Avondale A.00.003	1	2279	339	2618	803	80	61
Avondale A.00.004	1	512	4	516	519	18	1
Avondale A.00.005	1	2113	254	2367	800	74	46
Avondale A.01.001	3	2730	36	2766	1692	96	6
Avondale A.01.002	3	2319	69	2388	1296	81	12
Avondale A.01.003	3	870	0	870	1290	30	0
Avondale A.01.004	5	2413	82	2495	1510	84	15
Avondale A.02.004	2	1384	22	1406	889	48	4
Avondale A.02.007	2	1073	21	1094	859	38	4
Avondale A.04.001	1	1620	203	1823	581	57	37
Avondale A.04.002	1	1273	203	1476	447	45	37
Avondale A.04.003	1	876	34	910	441	31	6
Avondale A.04.004	1	1258	178	1436	457	44	32
Avondale A.04.005	2	705	11	716	616	25	2
Avondale A.04.007	1	1066	115	1181	442	37	21
		24851.779	1776.2208	26628	13685.17	£870	£320
		93.33%	6.67%		Avg:	£28.99	£10.66

D.2 Controls Philosophy

Clearly, heat from the Heat pump is much lower Carbon and lower cost than heat from the secondary heaters, therefore it is important that the controls arrangement ensures the MVHR heater coil is always the lead heat source and the electrical towel rail or wall-mounted panel heater is the lag. The secondary heating should just be used for local temperature trimming, such as raising the Bathroom to 24 deg C for an hour in the morning or evening while the rest of the apartment stays at 19 deg C, say, or raising the living room from 19 deg C to 21 deg C for a few hours per day. Furthermore, although the required heat outputs for 2 or 3 deg C temperature lift for a living room, say, are tiny (<50W) in practice commercially available heaters will generally be a minimum of 250-350W. This has a hidden benefit inasmuch as it provides 100% standby heating capacity for the duration of any Central Plant failure, but it also illustrates the need for a robust lead/lag controls strategy.

The elements of this controls strategy are as follows:

Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

1. The MVHR off-coil temperature is determined by outside temperature and a weather compensator curve (ie the colder it is outside the warmer the set-point on the supply air temperature), not a room thermostat. The heating runs 24/7, unless the holiday button is set.
2. The secondary heating panel heaters and towel rails will each have individual timeclocks and thermostatic controls, so that each room can have its own on and off times and temperature setpoints.
3. The Secondary heating will be fed from a dedicated electrical circuit with an energy monitor.

The question then arises: what happens if the controls are doing their lead/lag job perfectly, but an individual family just decide to turn their heating up? How does the Space Heating energy consumption vary compared to the “standard case” used by the SAP Calculations?

This is modelled below :

What if resident sets a different Mean Internal Temperature?						
	MIT	ASHP %ge	Elec %ge	ASHP HTG	Elec HTG	Total
	18	96.94%	3.06%	£18.57	£3.01	£18.57
	19	94.77%	5.23%	£23.62	£6.70	£30.33
SAP avg MIT	19.93	93.33%	6.67%	£28.99	£10.66	£39.65
	20	91.87%	8.13%	£29.89	£13.60	£43.49
	21	90.12%	9.88%	£35.40	£19.96	£55.36
	22	88.18%	11.82%	£42.21	£29.11	£71.32

It can be seen that the overall energy consumption ramps up with each extra deg C added to the Mean Internal Temperature, but the ratio of Heat Pump to Secondary does not change dramatically.

The reason for this is that, although increasing internal temperature *does* increase the heat loss by, say 40W when it is -3degC outside (and this extra heat will all come from the secondary heating), it will also increase the heat loss by the same 40 W when it is say 10 deg C outside and this will come from the heat pump. The big increase in annual energy consumption caused by raising a thermostat 1 deg doesn't come from the apartment needing 740W instead of 700W for the 7 hours a year when it is -3 degC outside; it comes from needing 80W instead of 40W for the 582 hours that it is 9 deg C outside. And 40W instead of 0W for the 499 hours it is 10 deg C outside.

D.3 Space Heating Seasonal Coefficient of Performance

“Seasonal” Coefficient of Performance describes performance of the unit over a typical season where the source temperature varies. Used mostly with Air Sourced Heat pumps where the source temperature varies considerably over the year and hence efficiency and/or output varies. Thus SCoP is dependant on the local climate.

It is also important to use the correct heat sink temperature: the temperature at which the heat is delivered.

Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

SCOP Data are available for the proposed Heat Pump / Air Collector from the MCS database of certified products.



flexoTHERM 15kW (400V) with aroCOLLECT
 Certification Number: KIWA 00023/013 HP
 Model Number: VWF 157/4 + VWA 11/4 SA + VWA 11/4 SA
 Certification Period: 08/01/2016 - Present

Product Details

Manufacturer:	Vaillant GmbH	Product Name:	flexoTHERM 15kW (400V) with aroCOLLECT
Model Number:	VWF 157/4 + VWA 11/4 SA + VWA 11/4 SA	Technology:	Air Source Heat Pump
Certification Body:	KIWA	Manufacturer's Website:	Visit manufacturer's website
Certification Period:	08/01/2016 - Present	Current Certification Status:	Certified

SCOP Values

Flow Temperature	SCOP
35°C	4.43
36°C	4.32
37°C	4.22
38°C	4.11
39°C	4.01
40°C	3.9

Using the total KWh of heat from the MVHR Coils (at 40 deg C water temperature) and the total from the panel heaters it is possible to calculate a combined SCOP as follows:

	Heat KWh	SCOP	Elec KWh
From Flexotherm	24851.8	3.9	6372.3
From Secondary	1776.2	1.0	1776.2
Totals	26628.0		8148.5
Combined SCOP		3.3	

Note: this is based upon a flow temperature of 40 deg C from the Heat Pump to the MVHR coils, in order to achieve an air supply temperature of 33 deg C. In milder weather, it should be possible to reduce the flow temperature to improve the SCOP slightly, but 3.3 serves as a “worst case figure” for the energy calculations.

Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

D.4 Domestic Hot Water Coefficient of Performance

The Domestic Hot water is served by 2 separate Air Source Heat Pumps. One of them maintains an unvented Domestic Hot Water Cylinder at 50 deg C, with a daily 65 deg Pasteurisation Cycle and the other maintains a thermal store at 35 deg C, containing treated LPHW in a closed system. The LPHW in the store is used via a plate heat exchanger to instantaneously heat the cold feed to hot water cylinder – raising it from typically 13 deg C to 31.5 deg C. (Note: the plate heat exchanger is located on the cold feed connection to the primary cylinder, to avoid having any domestic hot water resting at 31 deg C.)

The purpose of this arrangement is to divide the domestic hot water heating load into two parts; one of which is delivered at a Seasonal COP of 5.4 and the other at a SCOP of 3.8 to deliver a very high overall SCOP of around 4.4. Note this arrangement is *not* an ambient loop (2 heat pumps in series) it is 2 heat pumps taking different parts of a high temperature difference load.

The SCOP Figures are taken from the MCS Certificate for a “Grant Aeron3 R32 HPID13”. The resulting combine SCOP is 4.46. This drops to 4.40 if the Space Heating Heat pump is swapped for one of the Air Source heat pumps for say 8 weeks total per year.

Normal mode: One Grant Aeron3 at 54 deg C and another Aeron3 at 35 Deg C

Tin	Heat Req'd	SCOP	Electricity
13			
T1 31.5	18.5	5.4	3.43
T2 50	18.5	3.8	4.87
Totals	37		8.29
Combined SCOP		4.46	

Cooling Mode: One Grant Aeron3 at 54 deg C and one Vaillant at 35 deg C

Tin	Heat Req'd	SCOP	Electricity
13			
T1 31.5	18.5	4.43	4.18
T2 50	18.5	3.8	4.87
Totals	37		9.04
Combined SCOP		4.09	

Say 8 weeks in cooling mode and 44 in normal

Heat out = 37 x 52	1924
Elec in = 44 x 8.29 + 8 x 9.04	437.31
SCOP	4.40

Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021



Grant Aeron3 HPID13 R32 (for space heating and hot water)

Certification Number: BBA 0009/18
Model Number: Grant Aeron3 HPID13 R32
Certification Period: 06/06/2019 - Present

Product Details

Manufacturer:	Grant Engineering (UK) Ltd	Product Name:	Grant Aeron3 HPID13 R32 (for space heating and hot water)
Model Number:	Grant Aeron3 HPID13 R32	Technology:	Air Source Heat Pump
Certification Body:	BBA	Manufacturer's Website:	Visit manufacturer's website
Certification Period:	06/06/2019 - Present	Current Certification Status:	Certified

SCOP Values

Flow Temperature	SCOP
35°C	5.4
36°C	5.31
37°C	5.22
38°C	5.13
39°C	5.04
40°C	4.95



Grant Aeron3 HPID13 R32 (for space heating and hot water)

Certification Number: BBA 0009/18
Model Number: Grant Aeron3 HPID13 R32
Certification Period: 06/06/2019 - Present

Product Details

Manufacturer:	Grant Engineering (UK) Ltd	Product Name:	Grant Aeron3 HPID13 R32 (for space heating and hot water)
Model Number:	Grant Aeron3 HPID13 R32	Technology:	Air Source Heat Pump
Certification Body:	BBA	Manufacturer's Website:	Visit manufacturer's website
Certification Period:	06/06/2019 - Present	Current Certification Status:	Certified

SCOP Values

Flow Temperature	SCOP
50°C	4.11
51°C	4.03
52°C	3.95
53°C	3.88
54°C	3.8
55°C	3.72

D.5 Future Energy Flexibility

Should a DHN become available in the future, swapping the Heat Pumps for DHN heat interface units would be very straightforward. Furthermore, it is likely to operate at 70/40 deg C, which is of course much hotter than the LPHW temperatures we have used. At this point there would be little disadvantage to running the LPHW to the MVHR Coils at say 55 deg C, and making the electric panel

Avondale Drive Estate – Energy Statement and Sustainability Strategy Appendix D

Project/Ref: 07900 – Avondale Drive Estate

26/11/2021

heaters unnecessary (although, like a classic Passivhaus building, the ability to have different rooms at different temperatures would be limited).