LOVE
DESIGN
STUDIO

March 2023

Manor Lodge

Energy and Sustainability Statement

Contents

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Author: SK
Checked by: OE

Section Zero

0 Executive Summary

Executive Summary

An assessment of the site's sustainability and energy credentials has been carried out for the proposed development at Manor Lodge, Rickmansworth Road, Northwood. The proposed development is for the demolition of the existing structures and creation of 6 family residential units together with means of access and associated parking and landscaping. The site lies within the London Borough of Hillingdon.

The energy strategy follows the energy hierarchy; use less energy (Be Lean), supply energy efficiently (Be Clean), use renewable and low carbon energy (Be Green). The overall energy strategy capitalises on passive design measures to maximise the fabric energy efficiency and energy demand. The scheme then makes use of Air Source Heat Pumps (ASHPs) for space heating and domestic hot water to remove the need for on-site combustion.

The scheme utilises window reveals and balconies where feasible, to reduce the requirement for active cooling. Mechanical Ventilation with Heat Recovery (MVHR) will be included to help reduce the operational energy demand of the dwellings.

The proposed energy strategy has been set out within this report and the scheme is currently demonstrating a combined on-site regulated **CO_2 reduction of 65%** (Part L 2021 Baseline).

The site-wide results summary for the carbon emissions are set out on this page. Further detail may be found in the body of the report.

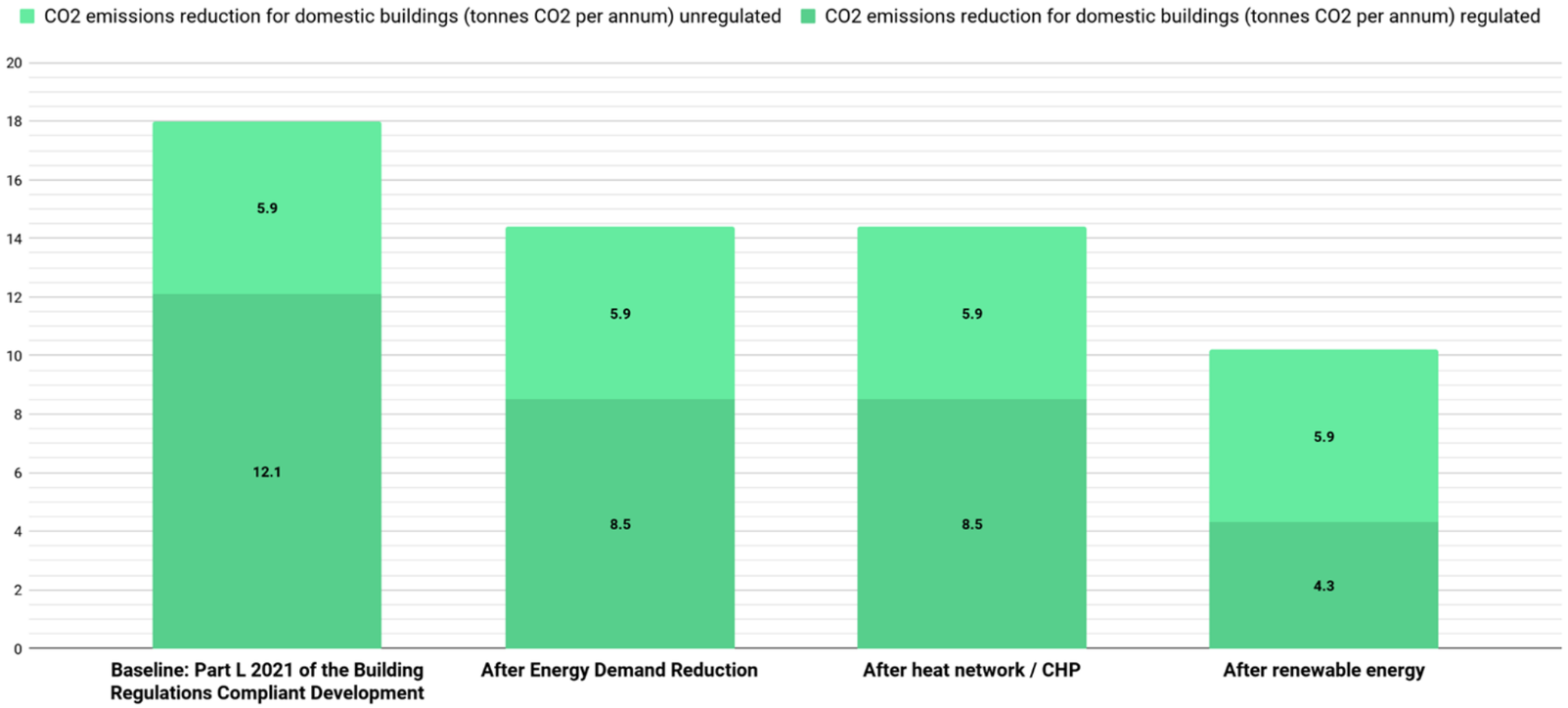


Figure 1: Total site-wide savings at each stage of the energy hierarchy

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	3.7	30%
Savings from heat network / CHP	0	0%
Savings from renewable energy	4.2	34%
Cumulative savings	**7.9**	**65%**

Table 1: Total site-wide savings at each stage of the energy hierarchy

Emissions within this report are based on the following CO_2 emission rates:

- Natural Gas 0.210 kgCO_2/kWh
- Grid electricity 0.136 kgCO_2/kWh

These represent the SAP 10.2 carbon factor figures. For the assessment of demand reduction measures (Be Lean stage) space heating and domestic hot water is assumed to be from gas boilers with an 89.5% efficient gas boiler, to standardize a benchmark target. However, the Be Green stage of the energy hierarchy results considers ASHPs as an alternative method for space heating and hot water.

Section One

1 Introduction

Site Overview

Love Design Studio have prepared this Energy and Sustainability Statement for the proposed development at Manor Lodge, Rickmansworth Road, Northwood. The site lies within the London Borough of Hillingdon.

The proposed development is for the demolition of the existing structures and creation of 6 family residential units together with means of access and associated parking and landscaping.

The purpose of this statement is to outline the sustainability credentials of the scheme and demonstrate the alignment of the proposed energy strategy with relevant national, regional, and local planning policy requirements.

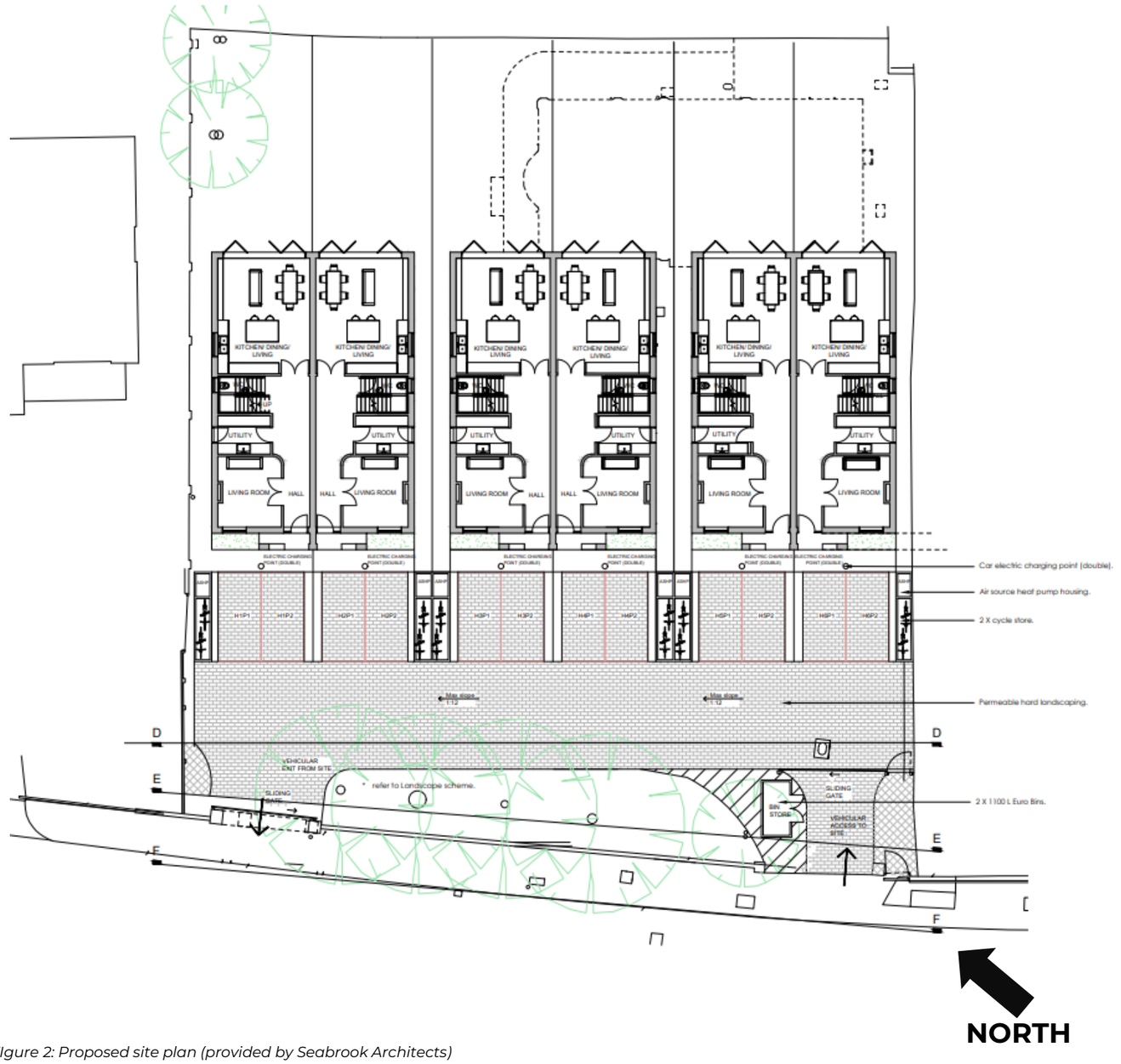


FIgure 2: Proposed site plan (provided by Seabrook Architects)

Planning Policy - National

National Planning Policy Framework (2021)

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced.

Planning law requires that applications for planning permission be determined in accordance with the development plan unless material considerations indicate otherwise. The National Planning Policy Framework must be considered in preparing the development plan and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements.

The purpose of the planning system is to contribute to the achievement of sustainable development. In summary the framework advises:

"Plans should take a proactive approach to mitigating and adapting to climate change, considering the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

New development should be planned for in ways that:

- *Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and*
- *Can help to reduce greenhouse gas emissions, such as through its location, orientation, and design. Any local requirements for the sustainability of buildings should reflect the government's policy for national technical standards.*

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- *Provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);*
- *Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and*
- *Identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.*

Planning Policy - Regional

London Plan (2021)

Under the legislation establishing the Greater London Authority (GLA), the Mayor is required to publish a Spatial Development Strategy (SDS) and keep it under review. The London Plan, published in 2021, is the overall strategic plan for London which sets out an integrated economic, environmental, and social framework for the development of London over the next 20-25 years.

The document brings together the geographical and locational aspects of the Mayor's other strategies, to ensure consistency with those strategies, including those dealing with transport, environment, economic development, housing, culture, and health inequalities.

The energy strategy of the proposed scheme has followed the energy hierarchy written in the key policy below.

POLICY SI 2 - MINIMISING GREENHOUSE GAS EMISSIONS

Policy SI 2 relates to major developments which follows the energy hierarchy below:

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.

Other policy extracts from the London Plan that are deemed relevant to Energy and/or Sustainability have been set out below for reference:

POLICY D6 - HOUSING QUALITY AND STANDARDS

POLICY G1 - GREEN INFRASTRUCTURE

POLICY G5 - URBAN GREENING

POLICY SI 1 - IMPROVING AIR QUALITY

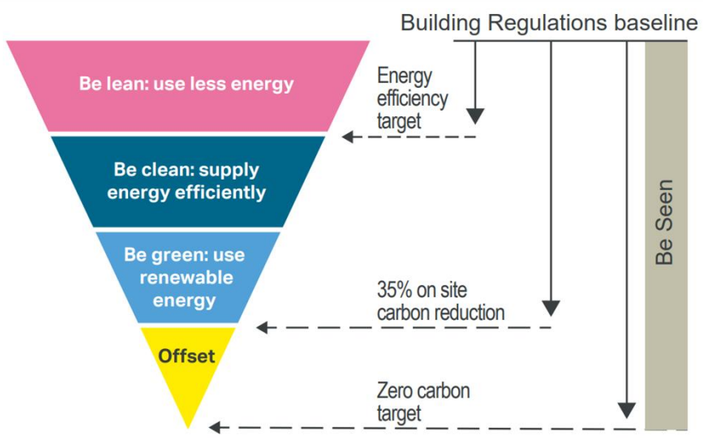
POLICY SI 3 - ENERGY INFRASTRUCTURE

POLICY SI 4 - MANAGING HEAT RISK

POLICY SI 5 - WATER INFRASTRUCTURE

POLICY SI 7 - REDUCING WASTE AND SUPPORTING THE CIRCULAR ECONOMY

Details of each policy are set out in Appendix A for reference.



Source: Greater London Authority

Figure 3: The energy hierarchy proposed in the London Plan 2021.

Planning Policy - Local

London Borough of Hillingdon

The London Borough of Hillingdon have a statutory guide to development within the borough and use policies and guides to do so. The Hillingdon Local Plan (2012) is the foundation for how planning is controlled in Hillingdon. The Local Plan is broken into two parts, with Part 1 focused on Strategic Policies and Part 2 comprising of Development Management Policies.

Furthermore, Hillingdon Council declared a climate emergency in January 2020; the Council is therefore committed to mitigating carbon emissions throughout the area.

The policies and requirements of new development within the borough which relate to this energy and sustainability statement, found in the Local Plan Part 1: Strategic Policies (2012) and Local Plan Part 2: Development Management Policies (2020), are expanded on in the following sections.

Hillingdon Local Plan Part 1 - Strategic Policies (2012)

The Hillingdon Local Plan is the principal planning document that sets out the vision, spatial strategy, and core policies that are used for shaping future development in the borough.

Regarding energy, the following policies have been acknowledged and applied:

Policy EM1 - Climate Change Adaptation and Mitigation'

- Ensuring development meets the highest possible design standards
- Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan.

Policy BE1 – Built Environment

- All new homes to contribute to tackling and adapting to climate change and reducing emissions of local air quality pollutants.
- All new development to achieve reductions in carbon dioxide emission in line with the London Plan targets through energy efficient design and effective use of low and zero carbon technologies.

The scheme will also look to adhere to the following policies pertaining to sustainability:

- *Policy EM7 - Biodiversity and Geological Conservation*
- *Policy EM6 - Flood Risk Management*
- *Policy EM8 - Land, Water, Air, Noise*
- *Policy EM11 - Sustainable Waste Management*

Hillingdon Local Plan Part 2: Development Management Policies (2020)

In particular, the following criteria under *Policy DMEI 2 'Reducing Carbon Emissions'* have been acknowledged:

- All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets

The scheme will also look to adhere to the following policies pertaining to sustainability:

- *DMEI 7 - Biodiversity Protection and Enhancement*
- *DMEI - 9 Management of Flood Risk*
- *DMEI - 10 Water Management, Efficiency and Quality*
- *DMEI 14 - Air Quality*
- *DMIN 4 - Re-use and Recycling of Aggregates*

Section Two

2 Energy

Methodology and Assumptions

The scheme looks to meet operational energy targets, in reference to the London Plan energy hierarchy (Policy SI 2 'Minimising Greenhouse Gases'):

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.

The final stage of the energy hierarchy 'Be Seen' has not been included in this statement as this planning application is for a minor development.

On the 15th June 2022, Part L (2013) Building Regulations were replaced by Part L (2021). The aim of this update is to improve the energy efficiency of new buildings. Some of the changes are listed below:

- 31% lower CO2 emissions required under part L (2021) in comparison to its 2013 counterpart
- Air tightness testing now mandatory
- Improvements to thermal bridging and building fabric targets

To achieve compliance with Part L 2021, the following assumptions, definitions, and methodology have been applied:

- SAP compliant software has been used to calculate the domestic carbon dioxide emissions for the scheme using SAP 10.2 carbon factors
- The Great London Authority's Carbon Emissions Reporting Spreadsheet 2022 (Version 2) was used calculate CO2 reduction targets for the scheme, in accordance with the GLA's guidance on Energy Statements.
- Completed checklists at this stage represent anticipated targets, post-construction testing will be required to confirm airtightness, ventilation and thermal bridging.
- Building fabric will be selected based on the U-values provided by the manufacturer to achieve a high level of building efficiency.
- Renewable technology, for the purpose of the report, includes for the provision of low carbon technologies, including heat-pump technology and photovoltaic solar panels.
- Drawings used to model the scheme are based on information received from Seabrook Architects on 3rd March 2023.
- A full copy of the SAP calculations is contained in Appendix C.

Be Lean

Passive Design Measures Summary

Overleaf sets out the inputs used for the SAP calculations to generate carbon emission reduction findings.

In summary, the scheme benefits from:

- An orientation that suits daylight and sunlight access.
- Being airtight, reducing draughts and heat loss.
- A well-insulated building fabric shell.
- Mechanical Ventilation with Heat Recovery
- 100% efficient lighting.

The Dwelling Fabric Energy Efficiency (DFEE) rating is greater than a 7% improvement upon building regulations standards (see table 4 overleaf).

For the assessment of demand reduction measures, space heating and domestic hot water is assumed to be from a gas boiler, to standardise a benchmark target. However, the subsequent sections of this report have set out an alternative method for space heating and hot water as a preferred solution.

See appendix A for the full Be Lean considerations.

Table 2: SAP Model inputs

Whole Scheme Technical Information			
Building Fabric	**Input**	**Unit**	**Comment**
External Wall U-value	0.14	W/m²K	Include unheated areas
Roof U-value	0.10	W/m²K	Include roof to terraces
Ground Floor U-value	0.10	W/m²K	-
Windows U-value	1.2	W/m²K	-
Doors U-Value	1.0	W/m²K	-
Technical Information			
Building Fabric	**Input**	**Unit**	**Comment**
Windows g-value	0.63	-	-
Frame-Factor	0.7	-	-
Thermal Mass Parameter	Medium (250 kJ/m²K)		Default value
Thermal Bridge Y-value	0.05	-	Thermal Bridging calculations to be carried out Post-Planning.
Ventilation Method	Titon CME2 Q Plus A		Mechanical Ventilation with Heat Recovery
Air permeability	3.0 @50Pa (m³/(h.m²))		A low air permeability required to improve MVHR efficiency

Table 3: Scheme overheating mitigation measures

Overheating Mitigation Measures	
1. Minimising Internal Heat	Pipe lengths minimised, insulated pipework.
2. Reducing heat entering	Balconies, window reveals
3. Use of thermal mass	Medium
4. Passive ventilation	Openable windows
5. Mechanical Ventilation	Mechanical Ventilation with Heat Recovery
6. Active cooling	None

Table 4: Area-weighted Fabric Energy Efficiency ratings for the scheme

	TFEE (kWh/m²/yr)	DFEE (kWh/m²/yr)	Improvement (%)
Development total	49.61	46.08	7

Be Clean

Heating Infrastructure

Once demand for energy has been minimised, planning applications should demonstrate how their energy systems will exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly to reduce CO_2 emissions.

As well as carbon dioxide emissions, all combustion processes can emit oxides of nitrogen (NO_x) and solid or liquid fuelled appliances (such as those using biomass or biodiesel) can also emit particulate matter. These pollutants contribute to poor air quality and can have negative impacts on the health of residents and occupants of the development. It is important that these impacts are considered in determining the heating strategy of a development.

Existing Networks, Planned Networks and Supplying Heat Beyond the Site Boundary

Where a heat network exists in the vicinity of the proposed development, the applicant should look to prioritise connection and provide evidence of active two-way correspondence with the network operator.

Applicants should investigate the potential for connecting the development to an existing heat network system by contacting the local borough, local heat network operators and nearby developments.

If there is not an existing network, the applicant must investigate whether a network is being planned for the area. Applicants should also investigate opportunities for expanding their heat network to supply heat to local developments and buildings outside the boundaries of their site, particularly if this has the potential to facilitate an area-wide heat network.

There are no existing or proposed heat networks located in the area; therefore, individual efficient space heating and domestic hot water systems are advised. There are no CO_2 savings at this stage of the energy hierarchy.

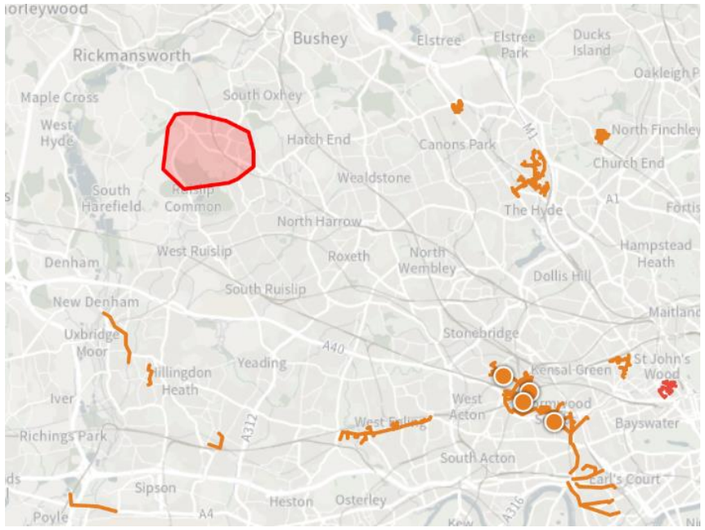


Figure 4: Site postcode HA6 (red), in relation to proposed heat networks (orange)

Be Green

Renewable Energy

Energy assessments should explain how the opportunities for producing, storing, and using renewable energy on-site will be maximised.

The capacity for renewable technologies at the site has been discussed with the wider design team. The following technologies were considered:

- Biomass
- Air Source Heat Pumps (ASHPs)
- Ground Source Heat Pumps (GSHPs)
- Photovoltaic Solar Panels
- Solar Thermal Hot Water
- Wind Technology

Of the above technologies it was decided that ASHPs are the most feasible and applicable for the scheme given the site constraints. A summary of each chosen technology is set out in the following sections.

A summary of the input details is set out on this page for reference use.

Table 8: Area-weighted Fabric Energy Efficiency ratings for the scheme

Technical Information		
Domestic Be Green Stage		
Space Heating System	Individual ASHPs	175.1% default efficiency, MCS certified
Heating Emitter	Radiators	-
Domestic Hot Water System	Same as space heating	-
Storage	Yes	~180 litres, 100mm foam insulation
Space Cooling System	No	-
Low/Zero Carbon Technologies used	ASHPs	175.1% default efficiency, MCS certified

Be Green

Air Source Heat Pumps (ASHPs)

Where heat pumps are proposed, a high specification of energy efficiency will be expected to ensure the system operates efficiently and to reduce peak electricity demand. This applies to any type of heat pump proposals including ASHPs, ground source heat pumps (GSHPs), water source heat pumps (WSHPs) or hybrid and ambient loop types of systems.

The details of the ASHPs will be provided at the detailed design stage; therefore, conservative efficiencies have been used for the purpose of this report based on default SAP figures for the residential uses.

Specifically, for ASHPs, evidence that the heat pump complies with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) product criteria are typically required for the relevant ASHP technology as well as evidence that the heat pump complies with other relevant issues as outlined in the Microgeneration Certification Scheme Heat Pump Product Certification.

Refrigerant pipe-runs will be minimised and will be in accordance with the specific supplier guidance. As the scheme comprises six dwellings, individual ASHPs will be specified rather than a communal system. As such, a fully insulated hot water cylinder should be supplied.

It is currently proposed that each of the condenser units are to be discreetly located in the bin store enclosure to the front of each dwelling.

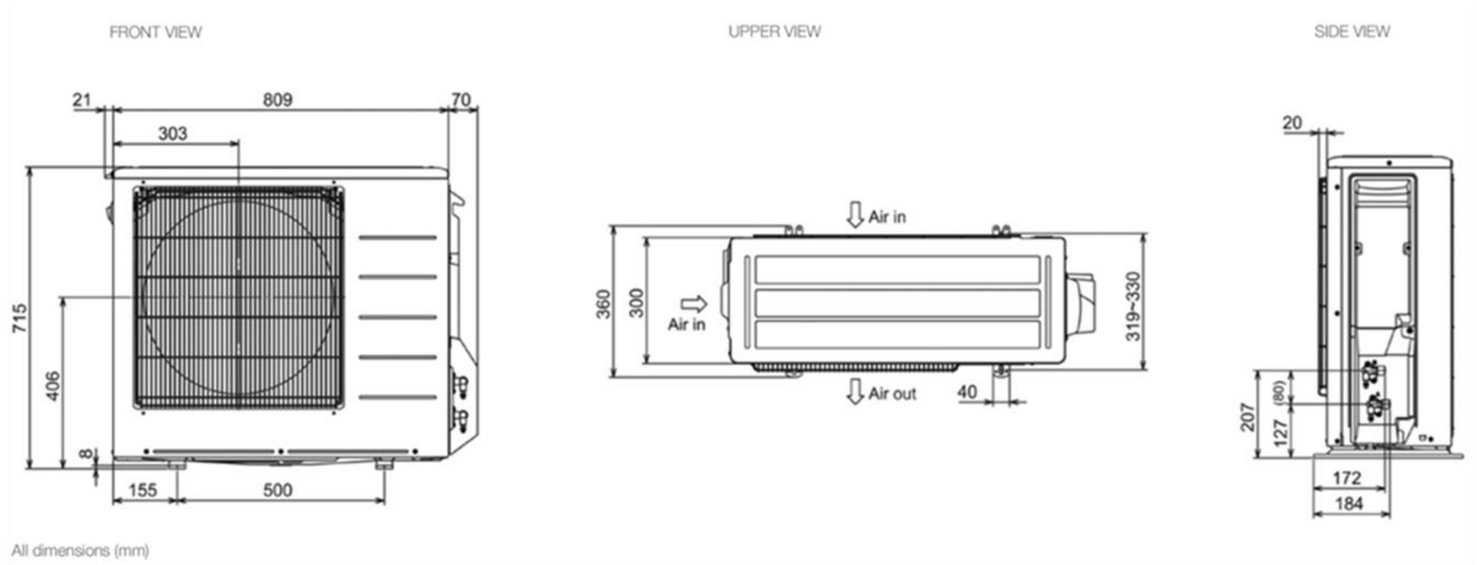


Figure 5: ©Mitsubishi QUHZ-W40VA example dimensions

Carbon Emission Results Summary

The energy strategy follows the energy hierarchy; use less energy (Be Lean), supply energy efficiently (Be Clean) and use renewable and low carbon energy (Be Green). The overall energy strategy capitalises on passive design measures to maximise the fabric energy efficiency and energy demand.

Following the energy hierarchy process, the applicant has opted for an individual ASHP solution per dwelling for space heating and domestic hot water, and mechanical ventilation with heat recovery.

Overall. the scheme meets a combined on-site regulated **CO_2 reduction of 65%** (Part L 2021 Baseline).

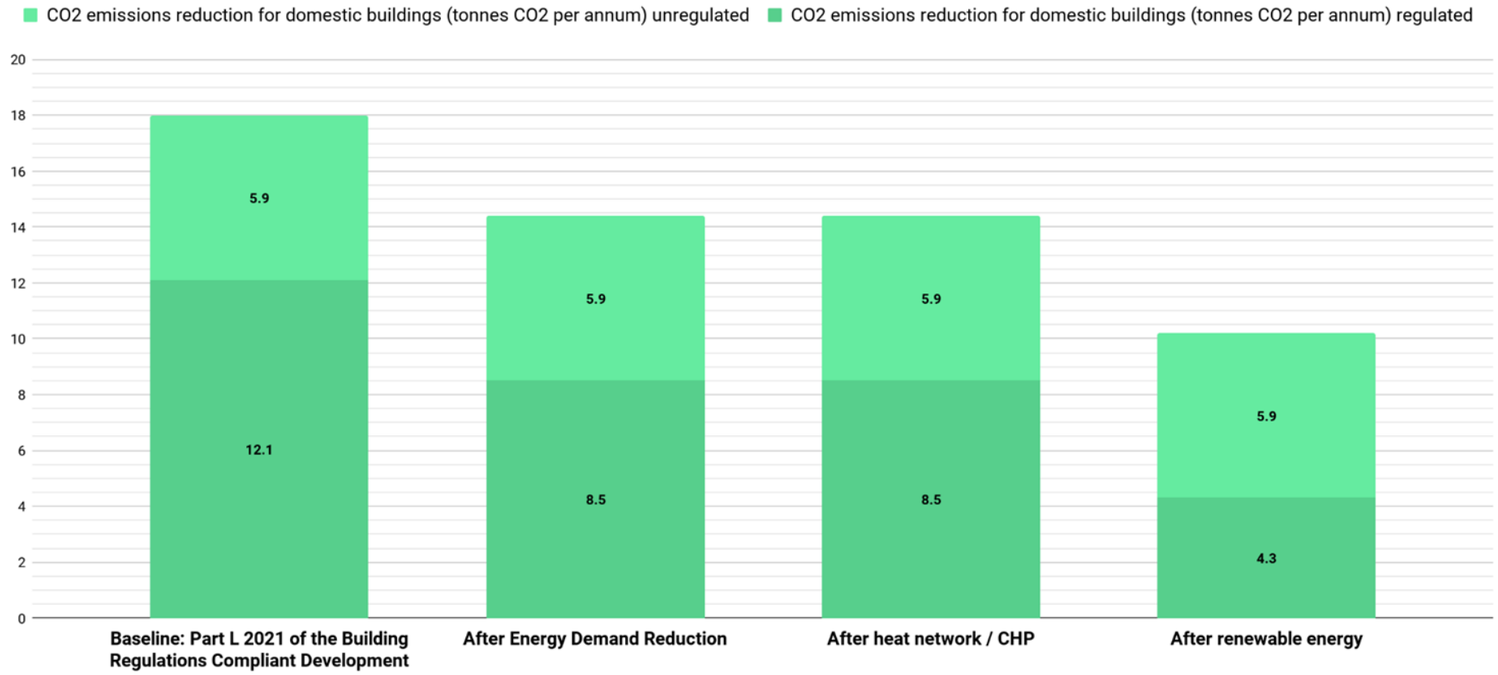


Figure 7: Total site-wide savings at each stage of the energy hierarchy

	Carbon dioxide emissions from domestic buildings (tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2021 of the Building Regulations Compliant Development	12.1	5.9
After energy demand reduction	8.5	5.9
After heat network / CHP	8.5	5.9
After renewable energy	4.3	5.9

Table 11: Total site-wide savings at each stage of the energy hierarchy

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	3.7	30%
Savings from heat network / CHP	0	0%
Savings from renewable energy	4.2	34%
Cumulative savings	**7.9**	**65%**

Table 12: Area-weighted Fabric Energy Efficiency ratings for the development

	TFEE (kWh/m²)	DFEE (kWh/m²)	Improvement (%)
Development total	49.61	46.08	7%

Primary Energy Rate Results Summary

As per Part L 2021, the target primary energy for newly constructed dwellings must be shown to be no higher than the target primary energy rate (TPER) associated with the notional dwelling. The table opposite provides a summary of the primary energy rate for the notional dwelling, i.e. the TPER, and compares this to the primary energy rate after the final stage of the energy hierarchy.

Overall, the scheme meets a combined on-site reduction of **29% against the TPER** (Part L 2021 Baseline).

Table 10: Primary energy rate after each stage of the energy hierarchy for domestic buildings (SAP 10.2)

	Primary Energy Rate	
	(kWh/m².year)	**% Reduction Against TPER**
Baseline: Part L 2021 of the Building Regulations Compliant Development	59.3	-
Proposed Scheme	41.7	29%

Section Three

3 Sustainability

Sustainability and Climate Change Appraisal

The sustainability credentials of the scheme have been set out in similar format to that of the, now defunct, Code for Sustainable Homes.

In a statement made on 25 March 2015, the Secretary of State for Communities and Local Government, Eric Pickles, confirmed that from 27 March 2015, changes to the 2008 Climate Change Act would mean local authorities in England could no longer require code level 3, 4, 5 or 6 as part of the conditions imposed on planning permissions. Applicants should work towards to the relevant Building Regulations standard; however, energy requirements for dwellings in the UK are now typically set by the Building Regulations equivalent to code level 4.

For the purpose of this assessment, we have used the Code as a method for assessing and demonstrating the residential part of the scheme's sustainability credentials and summarised the scheme's aspirations against each category

Energy Display Devices

The scheme will be provided with the ability to display energy consumption data and record energy use; this is to promote the specification of equipment to display energy consumption data, thus empowering dwelling occupants to reduce energy use.

Drying Space

To promote a reduced energy means of drying clothes. Space will look to be made available for the ability to dry clothes to avoid utilising heat energy.

Energy Labelled White Goods

Where white goods will be provided, the scheme will look to have them classified as energy efficient with at least an A-rating, where feasible. This is to promote the provision or purchase of energy efficient white goods, thus reducing the CO_2 emissions from appliance use in the dwelling.

External Lighting

All external space lighting, including lighting in common areas, will be provided by dedicated energy efficient fittings with appropriate control systems in-line with Building Regulations standards; this is to promote the provision of energy efficient external lighting, thus reducing CO_2 emissions associated with the dwelling.

Cycle Storage

The scheme will provide 2 cycle storage spaces per dwelling, as well as 2 additional short-stay spaces on-site. This is to promote the wider use of bicycles as transport by providing adequate and secure cycle storage facilities, thus reducing the need for short car journeys and the associated CO2 emissions.

Sustainable Transport

The site has PTAL rating of 2 as it is well connected to public transport routes. There are several bus routes on Rickmansworth Road and Maxwell Road; the nearest bus stop is being Northwood Golf Course (Stop V), circa 75m northwest. Additionally, Northwood Underground Station is approximately 750m northeast from the site. Electric vehicle charging points will be provided in a quantum that meets or exceeds policy requirements.

Home Office

The scheme should promote working from home by providing occupants with the necessary space and services, thus reducing the need to commute.

Sustainability and Climate Change Appraisal

Water and Surface Water Run-Off

Indoor Water Use

The water consumption criteria for the dwellings will be in line with 105 l/p/day in compliance with Policy EM8 'Land, Water, Air and Noise' of Hillingdon's Local Plan (Part 1).

External Water Use

Space should be made available for the provision of water butts in private amenity spaces; this is to promote the recycling of rainwater and reduce the number of mains potable water used for external water uses.

Management of Surface Water Run-off from Developments

To design surface water drainage for housing developments which avoid, reduce and delay the discharge of rainfall run-off to watercourses and public sewers, the scheme should use SuDS techniques; this will protect receiving waters from pollution and minimise the risk of flooding and other environmental damage in watercourses. Further information can be found in the supporting SuDS report.

Flood Risk

The site is located within Flood Zone 1 on the EA flood map, indicating a low probability of flooding from rivers and the sea.

Materials

Environmental Impact of Materials

To specify materials with lower environmental impacts over their life cycle; where feasible, key elements of the building Envelope will achieve an equivalent rating of A+ to D in the 2008 version of The Green Guide:

- Roof
- External walls
- Internal walls (including separating walls)
- Upper and ground floors (including separating floors)
- Windows.

Responsible Sourcing of Materials - Basic Building Elements

To promote the specification of responsibly sourced materials for the basic building elements; materials in the following Building Elements will be responsibly sourced:

a) Frame
b) Ground floor
c) Upper floors (including separating floors)
d) Roof
e) External walls
f) Internal walls (including separating walls)
g) Foundation/substructure (excluding sub-base materials)
h) Staircase

Additionally, timber in these elements will be legally sourced

Responsible Sourcing of Materials - Finishing Elements

To promote the specification of responsibly sourced materials for the finishing elements; materials in the following Finishing Elements will be responsibly sourced:

a) Staircase
b) Windows
c) External & internal doors
d) Skirting
e) Panelling
f) Furniture
g) Fascias
h) Any other significant use

Additionally, timber in these elements will be legally sourced

Sustainability and Climate Change Appraisal

Waste

Storage of Non-recyclable Waste and Recyclable Household Waste

Refuse space has been indicated on the ground floor of the proposed scheme. Space for recycling containers will:

- be located in an adequate external space
- be sized according to the frequency of collection
- store recyclable waste in identifiably different bins

Construction Site Waste Management

A compliant Site Waste Management Plan (SWMP) should be carried out setting out target benchmarks for waste, procedures for minimising hazardous waste and monitoring/measuring/reporting of hazardous and non-hazardous waste groups; this is to promote resource efficiency via the effective and appropriate management of construction site waste.

The SWMP should include procedures to sort and divert waste from landfill, through either:

a. Re-use on site (in situ or for new applications)
b. Re-use on other sites
c. Salvage/reclaim for re-use
d. Return to the supplier via a 'take-back' scheme
e. Recovery and recycling using an approved waste management contractor
f. Compost

according to the defined waste groups (in line with the waste streams generated by the scope of the works).

Composting

Space for individual home composting facilities will be provided to promote the provision of compost facilities to reduce the amount of household waste sent to landfill.

Pollution

Global Warming Potential (GWP) of Insulants

To promote the reduction of emissions of gases with high GWP associated with the manufacture, installation, use and disposal of foamed thermal and acoustic insulating materials; where feasible, insulating materials in the elements of the dwelling listed below will have a low GWP (in manufacture AND installation):

- Roofs: including loft access
- Walls: internal and external including lintels and all acoustic insulation
- Floors: including ground and upper floors
- Hot water cylinder: pipe insulation and other thermal stores
- Cold water storage tanks: where provided
- External doors

NOx Emissions

To promote the reduction of nitrogen oxide (NOX) emissions into the atmosphere; there will be no combustion boilers provided on-site within the dwellings.

Health and Wellbeing

Daylight

Living/kitchen spaces will look to meet at least a 1.5% Average Daylight Factor (ADF) and bedrooms meet at least a 1% ADF, where feasible; this is to promote good daylighting and thereby improve quality of life and reduce the need for energy to light the home.

Sound Insulation

Building materials will be chosen as such to improve the sound insulation between dwellings and to the main road; in-line with BS8223; this is to promote the provision of improved sound insulation to reduce the likelihood of noise complaints from neighbours.

Private Space

The scheme will look to improve quality of life by promoting the provision of an inclusive outdoor space which is at least partially private outdoor space (private or semi-private) has been provided that is:

- Of a minimum size that allows all occupants to use the space.
- Provided with inclusive access and usability.
- Accessible only to occupants of designated dwellings.

The scheme has indicated that all dwellings will be provided with private amenity space through a private garden to the rear of each unit.

Sustainability and Climate Change Appraisal

Management

Home User Guide

The scheme should look to provide a Home User Guide to the owner/tenants prior to handover to promote the provision of guidance enabling occupants to understand and operate their home efficiently and make the best use of local facilities.

Considerate Constructors Scheme

There is a commitment to meet best practice under a nationally or locally recognised certification scheme such as the Considerate Constructors Scheme; this is to promote the environmentally and socially considerate, and accountable management of construction sites.

Construction Site Impacts

To promote construction sites managed in a manner that mitigates environmental impacts; where feasible, there will be procedures that will typically cover one or more of the following items:

- Monitor, report and set targets for CO_2 production or energy use arising from site activities
- Monitor and report CO_2 or energy use arising from commercial transport to and from site
- Monitor, report and set targets for water consumption from site activities
- Adopt best practice policies in respect of air (dust) pollution arising from site activities
- · Adopt best practice policies in respect of water (ground and surface) pollution occurring on the site

Where feasible, 80% of site timber is reclaimed, re-used or responsibly sourced

Security

The principles of Secure by Design will be carried out for the scheme, to promote the design of developments where people feel safe and secure- where crime and disorder, or the fear of crime, does not undermine quality of life or community cohesion.

Ecology

To minimise reductions and promote an improvement in ecological value and enhance the ecological value of the site, the scheme should look to promote:

- development on land that already has a limited value to wildlife, and discourage the development of ecologically valuable sites.
- the protection of existing ecological features from substantial damage during the clearing of the site and the completion of construction works.
- the most efficient use of a building's footprint by ensuring that land and material use is optimised across the development.

Additionally, the site is not subject to any Tree Preservation Orders (TPOs).

Section Four

4. Conclusion

Conclusion

An assessment of the site's sustainability and energy credentials has been carried out for the proposed development at Manor Lodge, Rickmansworth Road, Northwood. The proposed development is for the demolition of the existing structures and creation of 6 family residential units together with means of access and associated parking and landscaping. The site lies within the London Borough of Hillingdon.

The energy strategy follows the energy hierarchy; use less energy (Be Lean), supply energy efficiently (Be Clean), use renewable and low carbon energy (Be Green). The overall energy strategy capitalises on passive design measures to maximise the fabric energy efficiency and energy demand. The scheme then makes use of Air Source Heat Pumps (ASHPs) for space heating and domestic hot water to remove the need for on-site combustion.

The scheme utilises window reveals and balconies where feasible, to reduce the requirement for active cooling. Mechanical Ventilation with Heat Recovery (MVHR) will be included to help reduce the operational energy demand of the dwellings.

The proposed energy strategy has been set out within this report and the scheme is currently demonstrating a combined on-site regulated **CO_2 reduction of 65%** (Part L 2021 Baseline).

The site-wide results summary for the carbon emissions are set out on this page. Further detail may be found in the body of the report.

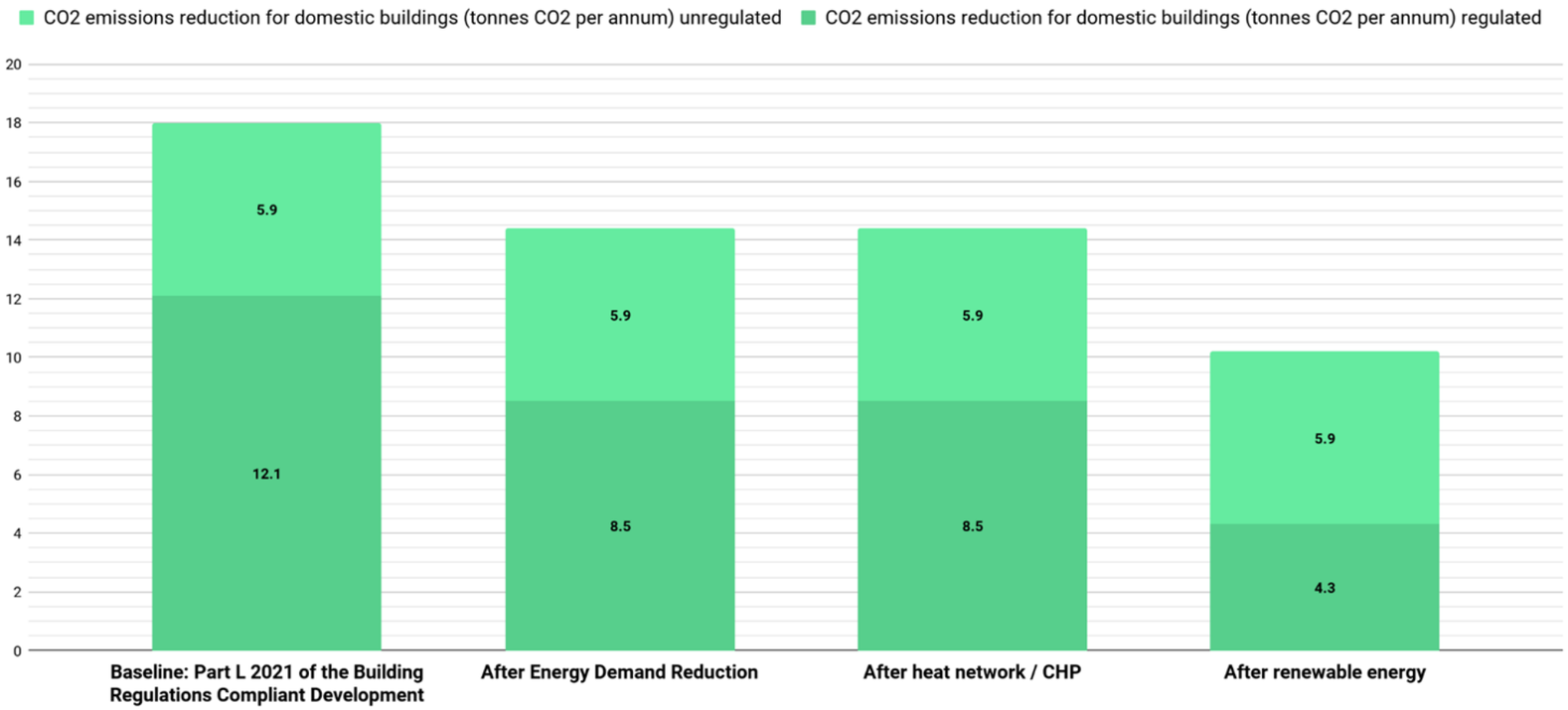


Figure 8: Total site-wide savings at each stage of the energy hierarchy

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	3.7	30%
Savings from heat network / CHP	0	0%
Savings from renewable energy	4.2	34%
Cumulative savings	**7.9**	**65%**

Table 13: Total site-wide savings at each stage of the energy hierarchy

Emissions within this report are based on the following CO_2 emission rates:

- Natural Gas 0.210 kgCO_2/kWh
- Grid electricity 0.136 kgCO_2/kWh

These represent the SAP 10.2 carbon factor figures. For the assessment of demand reduction measures (Be Lean stage) space heating and domestic hot water is assumed to be from gas boilers with an 89.5% efficient gas boiler, to standardize a benchmark target. However, the Be Green stage of the energy hierarchy results considers ASHPs as an alternative method for space heating and hot water.

Section Five

5 Appendices

Appendix A - Be Lean Considerations

Demand Reduction

Passive design measures, including optimising orientation and site layout, natural ventilation and lighting, thermal mass and solar shading are set out in this document. Active design measures, including high efficiency lighting and efficient low-energy extract systems, are also set out below. Building fabric details are set out in the tables at the end of this section (SAP 2012 carbon factor figures have been used throughout this assessment and then converted using SAP 10 carbon factors).

Building Insulation

Standard insulation materials are typically constructed from petrochemicals and include fibreglass, mineral wool, polystyrene, polyurethane foam, and multi-foils. These materials are typically inexpensive to both buy and install. However, these insulation materials contain many additives, and their process embodied energy is higher than natural insulation. Natural insulation products are typically defined as low impact to nature, generally being organic resources that have low embodied energy. They can be reused and recycled and are usually biodegradable. They tend to be more absorbent than standard man-made insulation materials reducing condensation issues. Thermal conductivity can be defined as the rate at which heat is transferred by conduction through a unit cross-section area of a material; the lower the thermal conductivity of the insulation materials the lower the rate of heat transfer through the wall, roof, or floor. This scheme will provide building insulation U-values improved upon the Building Regulations standard. At the detailed design stage both standard and natural insulation materials will be considered on merit, feasibility, and pricing.

Thermal Mass

Thermal mass is related to materials and the ability to absorb and store heat. High density materials like concrete, bricks and tiles require more energy to heat up; they are therefore considered to have high thermal mass. Lightweight materials such as timber have low thermal mass. For residential uses thermal mass is not commonly deemed to be the most reliable form of controlling heat build-up within spaces as heat may build up during the day in bedrooms during summer and may then be exhausted during the occupants sleeping period; therefore, for the SAP calculations the assumption of the thermal mass parameter is ‘medium’ (250 kJ/m²K).

Orientation & Site Layout

Orientation of dwellings is key in maximising the benefits of solar gain in the winter and improving daylight & sunlight access given the constraints of the site. Single aspect, south and southwest facing spaces should be minimised unless overheating mitigation measures are present.

Dual aspect facades, where feasible, promote better daylight and sunlight access. Facades also have significant opportunity for daylight and sunlight access to each dwelling.

The dwellings are predominantly northeast and southwest facing, allowing for cross ventilation.

Thermal Bridge Summary

Thermal Bridges (Linear) occur at junctions between elements, such as a wall and a floor or a window and a wall. At these locations heat can transfer more easily through the construction, resulting in greater heat loss from the dwelling and localised ‘cold spots’ in the building envelope. Improving junction details to reduce linear thermal bridging will help achieve Building Regulations compliance and in achieving healthy, low energy homes.

Accredited Construction Details (ACDs) to be implemented in the design and construction of the dwellings. ACD checklists to be completed and signed towards the end of construction.

Thermal junctions complied with are as follows:

- E5 Ground floor (normal)
- E6 Intermediate floor within a dwelling
- E14 Flat Roof
- E16 Corner (normal)
- E18 Party wall between dwellings

Lighting

Poorly lit areas can strain the eyes and increase the reliance of subsidiary lighting such as inefficient unregulated lamps. Health and wellbeing are proven to be linked to access to daylight and sunlight. Furthermore, inefficient lighting can lead to increased energy bills.

Within the property, all fixed light fittings will be low-energy lamps, including storage and infrequently accessed areas. The lux levels within each space will be designed to match relevant Building Regulations and industry guidance to reduce the requirement for additional unregulated lighting.

Appendix A - Be Lean Considerations

Materials

All construction materials will be considered, with particular focus given to minimising embodied carbon through the material's life cycle, from cradle to gate.

Natural Ventilation

Natural ventilation is a method of supplying fresh air to a space through passive means, typically by utilising differences in pressure and/or temperatures within a space.

The key for residential uses is to minimise the complexity of ventilation strategies; otherwise, the occupant may not manage the strategy appropriately.

All windows to habitable rooms should be openable to allow for maximum dispersion of heat and pollution build-up such as CO_2.

Mechanical Ventilation with Heat Recovery (MVHR)

Although passive ventilation should be maximised during temperate conditions, as this requires no fan power, there is the potential for heat to be lost to the atmosphere when fresh air is required (from opening windows) simultaneously with heating during colder seasons; therefore, it is advantageous to provide a form of heat recovery that allows for an efficient system that captures the heat exhausting from a room being heated in colder conditions.

All dwellings will be installed with mechanical ventilation heat recovery (MVHR) systems offering fresh air supply to the bedroom spaces and extract from the bathrooms and kitchens; meaning windows will not be required to be open to meet the minimum background ventilation rates.

The heat recovery aspect will lower space heating consumption. A summer bypass mode will allow for extracting of heat build-up during hotter periods.

©Titon images of a typical MVHR unit

Appendix B - SAP Inputs

Item	Comment		
General			
Description	Demolition of the existing structures and creation of 6 family residential units together with means of access and associated parking and landscaping		
Calculation method	Elmhurst Design SAP 10 & Approved Document Part L 2021		
Technical Information			
Building Fabric	**Input**	**Unit**	**Comment**
External Wall U-value	0.14	W/m²K	
Roof U-value	0.10	W/m²K	Including roof to terraces
Ground Floor U-value	0.10	W/m²K	-
Windows U-value	1.2	W/m²K	Not including frame
Windows g-value	0.63	-	-
Window Frame-Factor	0.7	-	-
Thermal Mass Parameter	Medium	TMP	Default value
Thermal Bridging Y-value	0.05	-	Thermal Bridging calculations TBD
Ventilation Method **System Assumptions**	Titon CME2 Q Plus A	-	Mechanical Ventilation with Heat Recovery
Air permeability	3.0	@50Pa (m³/(h.m²))	-
Be Lean Stage			
Space Heating System	Gas Boiler		89.5% efficiency
Heating Emitter	Radiators		-
Domestic Hot Water System	Same as space heating		-
Storage	Yes		~180 litres, 100mm foam insulation
Space Cooling System	No		-
Be Clean Stage			
Space Heating System	Gas Boiler		89.5% efficiency
Heating Emitter	Radiators		-
Domestic Hot Water System	Same as space heating		-
Storage	Yes		~180 litres, 100mm foam insulation
Space Cooling System	No		-
Be Green Stage			
Space Heating System	ASHPs		175.1% default efficiency, MCS certified
Heating Emitter	Radiators		-
Domestic Hot Water System	Same as space heating		-
Storage	Yes		~180 litres, 100mm foam insulation
Space Cooling System	No		-
Low/Zero Carbon Technologies used	ASHPs		175.1% default efficiency, MCS certified

Appendix C - SAP DER/TER Worksheets

Full SAP Calculation Printout

Property Reference	Manor Lodge L	Issued on Date	13/01/2023
Assessment Reference	Be Lean_Manor Lodge	Prop Type Ref	Manor Lodge
Property			

SAP Rating	84 B	DER	10.73	TER	11.43
Environmental	89 B	% DER < TER			6.12
CO_2 Emissions (t/year)	1.64	DFEE	46.78	TFEE	50.32
Compliance Check	See BREL	% DFEE < TFEE			7.04
% DPER < TPER	-5.69	DPER	63.55	TPER	60.13

Assessor Details	Mr. Andy Love	Assessor ID	U860-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.1200 (1b)	x	3.7500 (2b)	=	289.2000 (1b)	-
First floor	56.0700 (1c)	x	2.9300 (2c)	=	164.2851 (1c)	-
Second floor	46.5300 (1d)	x	3.7000 (2d)	=	172.1610 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	625.6461	(5)

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2. Ventilation rate
---

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388 (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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

Effective ac	0.2809	0.2774	0.2740	0.2566	0.2532	0.2358	0.2358	0.2323	0.2427	0.2532	0.2601	0.2670	(25)

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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	
Window (Uw = 1.20)			36.1200	1.1450	41.3588			(27)

Door			4.7400	1.0000	4.7400	(26)
Heatloss Floor 1			77.1200	0.1000	7.7120	(28a)
External Wall 1	228.6900	40.8600	187.8300	0.1400	26.2962	(29a)
External Roof 1	12.0600		12.0600	0.1000	1.2060	(30)
External Roof 2	21.2000		21.2000	0.1000	2.1200	(30)
Total net area of external elements Aum(A, m2)			339.0700			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.4330	(33)
Party Wall 1			56.2400	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		16.9535 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	100.3865 (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	57.9968	57.2806	56.5645	52.9836	52.2675	48.6866	48.6866	47.9704	50.1189	52.2675	53.6998	55.1321	(38)
Heat transfer coeff	158.3833	157.6671	156.9509	153.3701	152.6539	149.0731	149.0731	148.3569	150.5054	152.6539	154.0863	155.5186	(39)
Average = Sum(39)m / 12 =												153.1911	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8813	0.8773	0.8733	0.8534	0.8494	0.8295	0.8295	0.8255	0.8374	0.8494	0.8574	0.8653	(40)
HLP (average)												0.8524	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9754	(42)
Hot water usage for mixer showers	74.1083	72.9946	71.3717	68.2666	65.9751	63.4197	61.9672	63.5778	65.3433	68.0871	71.2589	73.8244	(42a)
Hot water usage for baths	31.9922	31.5171	30.8480	29.6143	28.6906	27.6663	27.1130	27.7774	28.5008	29.5969	30.8559	31.8841	(42b)
Hot water usage for other uses	45.1015	43.4615	41.8214	40.1814	38.5413	36.9013	36.9013	38.5413	40.1814	41.8214	43.4615	45.1015	(42c)
Average daily hot water use (litres/day)												138.9886	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.2021	147.9732	144.0412	138.0623	133.2070	127.9873	125.9815	129.8965	134.0255	139.5054	145.5763	150.8100	(44)
Energy conte	239.4671	210.7118	221.3859	189.0004	179.3223	157.3753	152.3637	160.8390	165.2669	189.3075	207.4001	236.1320	(45)
Energy content (annual)										Total = Sum(45)m =		2308.5720	
Distribution loss (46)m = 0.15 x (45)m	35.9201	31.6068	33.2079	28.3501	26.8983	23.6063	22.8545	24.1259	24.7900	28.3961	31.1100	35.4198	(46)

Water storage loss:		
Store volume		180.0000 (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		0.8736 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		0.8736 (55)

Total storage loss	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(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)
Combi 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	(61)
Total heat required for water heating calculated for each month	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764	(64)
										Total per year (kWh/year) = Sum(64)m =		2901.3371	(64)
12Total per year (kWh/year)												2901	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	119.8984	106.4396	113.8864	101.8190	99.9002	91.3036	90.9365	93.7545	93.9276	103.2203	107.9369	118.7894	(65)

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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	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.3682	197.4791	178.3682	184.3138	178.3682	184.3138	178.3682	178.3682	184.3138	178.3682	184.3138	178.3682	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	351.3376	354.9834	345.7962	326.2376	301.5484	278.3440	262.8420	259.1963	268.3835	287.9421	312.6313	335.8357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	(71)
Water heating gains (Table 5)													

	161.1537	158.3923	153.0731	141.4153	134.2745	126.8106	122.2264	126.0141	130.4550	138.7369	149.9123	159.6632	(72)
Total internal gains	761.4913	781.4865	747.8692	722.5984	684.8228	657.1001	631.0684	631.2103	650.7840	675.6790	717.4892	744.4988	(73)

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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	
Northeast	19.7800	11.2829	0.6300	0.7000	0.7700	68.2057	(75)
Southwest	10.2600	36.7938	0.6300	0.7000	0.7700	115.3704	(79)
Northwest	6.0800	11.2829	0.6300	0.7000	0.7700	20.9651	(81)

Solar gains	204.5412	378.0281	595.9079	870.2270	1095.0901	1140.1147	1077.1595	901.3074	689.6281	439.0140	250.3870	171.5543	(83)
Total gains	966.0325	1159.5147	1343.7770	1592.8254	1779.9128	1797.2148	1708.2279	1532.5177	1340.4121	1114.6930	967.8762	916.0532	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	78.7997	79.1576	79.5188	81.3754	81.7572	83.7211	83.7211	84.1252	82.9243	81.7572	80.9972	80.2512	
alpha	6.2533	6.2772	6.3013	6.4250	6.4505	6.5814	6.5814	6.6083	6.5283	6.4505	6.3998	6.3501	
util living area	0.9988	0.9960	0.9849	0.9217	0.7515	0.5270	0.3835	0.4441	0.7361	0.9672	0.9966	0.9992	(86)
MIT	19.9463	20.1316	20.4018	20.7556	20.9482	20.9956	20.9995	20.9989	20.9672	20.6785	20.2583	19.9322	(87)
Th 2	20.1834	20.1868	20.1902	20.2073	20.2107	20.2279	20.2279	20.2313	20.2210	20.2107	20.2039	20.1971	(88)
util rest of house	0.9984	0.9947	0.9799	0.8992	0.7013	0.4652	0.3165	0.3706	0.6675	0.9531	0.9953	0.9989	(89)
MIT 2	18.9351	19.1746	19.5197	19.9630	20.1695	20.2254	20.2277	20.2309	20.1995	19.8830	19.3503	18.9274	(90)
Living area fraction									fLA = Living area / (4) =			0.1841	(91)
MIT	19.1213	19.3508	19.6821	20.1089	20.3129	20.3672	20.3698	20.3723	20.3409	20.0295	19.5175	19.1124	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9713	19.2008	19.5321	19.9589	20.1629	20.2172	20.2198	20.2223	20.1909	19.8795	19.3675	18.9624	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9925	0.9745	0.8909	0.6981	0.4643	0.3158	0.3697	0.6647	0.9454	0.9932	0.9982	(94)
Useful gains	963.6954	1150.7824	1309.5256	1419.0622	1242.5301	834.4345	539.4292	566.5608	890.9778	1053.8647	961.3168	914.4407	(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	2323.6908	2254.7683	2045.4029	1696.1064	1291.8904	837.3785	539.6169	567.0618	916.7081	1416.5535	1890.2480	2295.8334	(97)
Space heating kWh	1011.8366	741.8786	547.4928	199.4718	36.7241	0.0000	0.0000	0.0000	0.0000	269.8405	668.8304	1027.7562	(98a)
Space heating requirement - total per year (kWh/year)												4503.8308	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1011.8366	741.8786	547.4928	199.4718	36.7241	0.0000	0.0000	0.0000	0.0000	269.8405	668.8304	1027.7562	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4503.8308	
Space heating per m2										(98c) / (4) =		25.0603	(99)

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 %)	89.5000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1011.8366	741.8786	547.4928	199.4718	36.7241	0.0000	0.0000	0.0000	0.0000	269.8405	668.8304	1027.7562	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	1130.5437	828.9146	611.7237	222.8735	41.0325	0.0000	0.0000	0.0000	0.0000	301.4977	747.2966	1148.3309	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764 (64)
Efficiency of water heater												89.5000 (216)
(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 (217)
Fuel for water heating, kWh/month												
	323.8118	286.2394	303.6093	265.6099	256.6109	230.2745	226.4895	235.9592	239.0919	267.7675	286.1682	320.0854 (219)
Space cooling fuel requirement												
(221)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 (221)
Pumps and Fa	81.8554	73.9339	81.8554	79.2149	81.8554	79.2149	81.8554	81.8554	79.2149	81.8554	79.2149	81.8554 (231)
Lighting	49.6296	39.8147	35.8487	26.2643	20.2873	16.5749	18.5068	24.0558	31.2461	40.9966	46.3055	51.0090 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)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 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)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 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)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 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)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 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)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 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)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 (235d)

Annual totals kWh/year

Space heating fuel - main system 1	5032.2132 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3241.7174 (219)
Space cooling fuel	0.0000 (221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.1500)	
mechanical ventilation fans (SFP = 1.1500)	877.7815 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	963.7815 (231)
Electricity for lighting (calculated in Appendix L)	400.5394 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	9638.2515 (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	5032.2132	0.2100	1056.7648	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3241.7174	0.2100	680.7607	(264)
Space and water heating			1737.5254	(265)
Pumps, fans and electric keep-hot	963.7815	0.1387	133.6884	(267)
Energy for lighting	400.5394	0.1443	57.8102	(268)
Total CO2, kg/year			1929.0240	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.7300	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5032.2132	1.1300	5686.4009	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3241.7174	1.1300	3663.1407	(278)
Space and water heating			9349.5416	(279)
Pumps, fans and electric keep-hot	963.7815	1.5128	1458.0086	(281)
Energy for lighting	400.5394	1.5338	614.3607	(282)
Total Primary energy kWh/year			11421.9110	(286)
Dwelling Primary energy Rate (DPER)			63.5500	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.1200 (1b)	x	3.7500 (2b)	=	289.2000 (1b)	-
First floor	56.0700 (1c)	x	2.9300 (2c)	=	164.2851 (1c)	-
Second floor	46.5300 (1d)	x	3.7000 (2d)	=	172.1610 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	625.6461	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0639	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3139	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2904	(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	0.3702	0.3630	0.3557	0.3194	0.3122	0.2759	0.2759	0.2686	0.2904	0.3122	0.3267	0.3412	(22b)
Effective ac	0.5685	0.5659	0.5633	0.5510	0.5487	0.5381	0.5381	0.5361	0.5422	0.5487	0.5534	0.5582	(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 Opaque door			4.7400	1.0000	4.7400			(26)
TER Opening Type (Uw = 1.20)			36.1200	1.1450	41.3588			(27)
Heatloss Floor 1			77.1200	0.1300	10.0256			(28a)
External Wall 1	228.6900	40.8600	187.8300	0.1800	33.8094			(29a)
External Roof 1	12.0600		12.0600	0.1100	1.3266			(30)
External Roof 2	21.2000		21.2000	0.1100	2.3320			(30)
Total net area of external elements Aum(A, m2)			339.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.5924			(33)
Party Wall 1			56.2400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	25.0000	0.0500	1.2500
E3	Sill	22.7000	0.0500	1.1350
E4	Jamb	49.8000	0.0500	2.4900
E5	Ground floor (normal)	25.2800	0.1600	4.0448
E6	Intermediate floor within a dwelling	42.0600	0.0000	0.0000
E16	Corner (normal)	20.7600	0.0900	1.8684
E18	Party wall between dwellings	20.7600	0.0600	1.2456

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.0338	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	105.6262	(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	117.3828	116.8333	116.2947	113.7647	113.2914	111.0879	111.0879	110.6799	111.9367	113.2914	114.2490	115.2501	(38)
Heat transfer coeff	223.0090	222.4595	221.9208	219.3909	218.9176	216.7141	216.7141	216.3061	217.5629	218.9176	219.8751	220.8762	(39)
Average = Sum(39)m / 12 =												219.3887	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2409	1.2378	1.2348	1.2207	1.2181	1.2058	1.2058	1.2036	1.2106	1.2181	1.2234	1.2290	(40)
HLP (average)												1.2207	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9754 (42)

Hot water usage for mixer showers

74.1083	72.9946	71.3717	68.2666	65.9751	63.4197	61.9672	63.5778	65.3433	68.0871	71.2589	73.8244 (42a)

Hot water usage for baths

31.9922	31.5171	30.8480	29.6143	28.6906	27.6663	27.1130	27.7774	28.5008	29.5969	30.8559	31.8841 (42b)

Hot water usage for other uses

45.1015	43.4615	41.8214	40.1814	38.5413	36.9013	36.9013	38.5413	40.1814	41.8214	43.4615	45.1015 (42c)

Average daily hot water use (litres/day) 138.9886 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	151.2021	147.9732	144.0412	138.0623	133.2070	127.9873	125.9815	129.8965	134.0255	139.5054	145.5763	150.8100	(44)
Energy conte	239.4671	210.7118	221.3859	189.0004	179.3223	157.3753	152.3637	160.8390	165.2669	189.3075	207.4001	236.1320	(45)
Energy content (annual)										Total = Sum(45)m =		2308.5720	
Distribution loss (46)m = 0.15 x (45)m													
	35.9201	31.6068	33.2079	28.3501	26.8983	23.6063	22.8545	24.1259	24.7900	28.3961	31.1100	35.4198	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi 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	(61)
Total heat required for water heating calculated for each month													
	288.7098	255.1891	270.6286	236.6546	228.5650	205.0295	201.6063	210.0817	212.9211	238.5501	255.0543	285.3747	(62)
WWHRS	-33.8792	-29.9631	-31.3756	-25.9802	-24.2126	-20.7189	-19.4207	-20.6520	-21.4366	-25.2714	-28.6294	-33.2518	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	254.8306	225.2260	239.2530	210.6744	204.3523	184.3105	182.1856	189.4297	191.4845	213.2787	226.4249	252.1228	(64)
										Total per year (kWh/year) = Sum(64)m =		2573.5731	(64)
12Total per year (kWh/year)												2574	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	119.0170	105.6435	113.0049	100.9660	99.0188	90.4506	90.0551	92.8731	93.0746	102.3389	107.0839	117.9080	(65)

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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	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	178.3682	197.4791	178.3682	184.3138	178.3682	184.3138	178.3682	178.3682	184.3138	178.3682	184.3138	178.3682	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	351.3376	354.9834	345.7962	326.2376	301.5484	278.3440	262.8420	259.1963	268.3835	287.9421	312.6313	335.8357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	(71)
Water heating gains (Table 5)													
	159.9690	157.2076	151.8884	140.2306	133.0898	125.6259	121.0417	124.8295	129.2703	137.5522	148.7276	158.4785	(72)
Total internal gains													
	760.3066	780.3018	746.6845	721.4137	683.6381	655.9154	629.8837	630.0256	649.5993	674.4943	716.3045	743.3142	(73)

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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	
Northeast	19.7800	11.2829	0.6300	0.7000	0.7700	68.2057	(75)
Southwest	10.2600	36.7938	0.6300	0.7000	0.7700	115.3704	(79)
Northwest	6.0800	11.2829	0.6300	0.7000	0.7700	20.9651	(81)

Solar gains	204.5412	378.0281	595.9079	870.2270	1095.0901	1140.1147	1077.1595	901.3074	689.6281	439.0140	250.3870	171.5543	(83)
Total gains	964.8478	1158.3300	1342.5923	1591.6407	1778.7282	1796.0301	1707.0432	1531.3330	1339.2274	1113.5083	966.6915	914.8685	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9644	56.1026	56.2388	56.8873	57.0103	57.5900	57.5900	57.6986	57.3653	57.0103	56.7620	56.5047	
alpha	4.7310	4.7402	4.7493	4.7925	4.8007	4.8393	4.8393	4.8466	4.8244	4.8007	4.7841	4.7670	
util living area	0.9988	0.9968	0.9908	0.9636	0.8784	0.7076	0.5434	0.6191	0.8719	0.9832	0.9972	0.9990	(86)
MIT	19.3802	19.5752	19.8912	20.3399	20.7210	20.9314	20.9846	20.9723	20.8033	20.3037	19.7685	19.3555	(87)
Th 2	19.8874	19.8899	19.8922	19.9034	19.9055	19.9153	19.9153	19.9171	19.9116	19.9055	19.9013	19.8969	(88)
util rest of house	0.9983	0.9956	0.9873	0.9492	0.8317	0.6124	0.4172	0.4882	0.8036	0.9743	0.9960	0.9987	(89)
MIT 2	17.9954	18.2466	18.6512	19.2209	19.6659	19.8759	19.9105	19.9072	19.7692	19.1856	18.5027	17.9703	(90)
Living area fraction										fLA = Living area / (4) =		0.1841	(91)
MIT	18.2504	18.4912	18.8795	19.4269	19.8601	20.0702	20.1083	20.1033	19.9596	19.3915	18.7357	18.2253	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2504	18.4912	18.8795	19.4269	19.8601	20.0702	20.1083	20.1033	19.9596	19.3915	18.7357	18.2253	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9934	0.9827	0.9410	0.8294	0.6271	0.4404	0.5121	0.8073	0.9682	0.9941	0.9979	(94)
Useful gains	962.2278	1150.7322	1319.3146	1497.6747	1475.2449	1126.2704	751.8029	784.1375	1081.1244	1078.1000	960.9559	912.9426	(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	3111.0628	3023.4934	2747.2750	2309.5069	1786.3966	1185.4797	760.2942	801.0475	1274.8214	1924.6082	2558.4076	3097.8644	(97)
Space heating kWh	1598.7332	1258.4955	1062.4025	584.5191	231.4968	0.0000	0.0000	0.0000	0.0000	629.8021	1150.1652	1625.5819	(98a)
Space heating requirement - total per year (kWh/year)												8141.1964	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1598.7332	1258.4955	1062.4025	584.5191	231.4968	0.0000	0.0000	0.0000	0.0000	629.8021	1150.1652	1625.5819	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8141.1964	
Space heating per m2											(98c) / (4) =	45.2993	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1598.7332	1258.4955	1062.4025	584.5191	231.4968	0.0000	0.0000	0.0000	0.0000	629.8021	1150.1652	1625.5819	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	1732.1053	1363.4838	1151.0320	633.2818	250.8091	0.0000	0.0000	0.0000	0.0000	682.3424	1246.1161	1761.1938	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	254.8306	225.2260	239.2530	210.6744	204.3523	184.3105	182.1856	189.4297	191.4845	213.2787	226.4249	252.1228	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4441	87.3053	86.9966	86.2236	84.3402	79.8000	79.8000	79.8000	79.8000	86.3367	87.1827	87.4753	(217)
Fuel for water heating, kWh/month	291.4210	257.9751	275.0143	244.3348	242.2953	230.9656	228.3028	237.3806	239.9555	247.0313	259.7131	288.2217	(219)
Space cooling fuel requirement													
(221)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	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	37.0614	29.7320	26.7704	19.6131	15.1498	12.3775	13.8201	17.9639	23.3333	30.6146	34.5791	38.0914	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-68.1546	-94.1110	-132.4802	-145.6890	-154.2659	-142.8151	-140.8514	-134.2156	-122.2883	-105.8505	-74.1404	-59.1407	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)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	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)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	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-44.7642	-93.3712	-184.2046	-274.7715	-361.6163	-362.8863	-358.8004	-304.7345	-224.4883	-133.1194	-59.6132	-35.4763	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)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	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)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	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)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	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												8820.3644	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)

Efficiency of water heater		79.8000
Water heating fuel used		3042.6111 (219)
Space cooling fuel		0.0000 (221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year		86.0000 (231)
Electricity for lighting (calculated in Appendix L)		299.1067 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-3811.8492 (233)
Wind generation		0.0000 (234)
Hydro-electric generation (Appendix N)		0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (235)
Appendix Q - special features		
Energy saved or generated		-0.0000 (236)
Energy used		0.0000 (237)
Total delivered energy for all uses		8436.2330 (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	8820.3644	0.2100	1852.2765	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3042.6111	0.2100	638.9483	(264)
Space and water heating			2491.2249	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	299.1067	0.1443	43.1703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1374.0029	0.1351	-185.5875	
PV Unit electricity exported	-2437.8463	0.1261	-307.3822	
Total			-492.9697	(269)
Total CO2, kg/year			2053.3547	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.4300	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	8820.3644	1.1300	9967.0118	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3042.6111	1.1300	3438.1505	(278)
Space and water heating			13405.1623	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	299.1067	1.5338	458.7798	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1374.0029	1.4992	-2059.9403	
PV Unit electricity exported	-2437.8463	0.4628	-1128.3229	
Total			-3188.2632	(283)
Total Primary energy kWh/year			10805.7798	(286)
Target Primary Energy Rate (TPER)			60.1300	(287)

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Full SAP Calculation Printout

Property Reference	Manor Lodge R	Issued on Date	13/01/2023
Assessment Reference	Be Green_Manor Lodge_R	Prop Type Ref	Manor Lodge
Property			

SAP Rating	80 C	DER	3.94	TER	11.10
Environmental	96 A	% DER < TER			64.50
CO_2 Emissions (t/year)	0.62	DFEE	45.37	TFEE	48.90
Compliance Check	See BREL	% DFEE < TFEE			7.22
% DPER < TPER	29.33	DPER	41.26	TPER	58.39

Assessor Details	Mr. Andy Love	Assessor ID	U860-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.1200 (1b)	x	3.7500 (2b)	=	289.2000 (1b)	-
First floor	56.0700 (1c)	x	2.9300 (2c)	=	164.2851 (1c)	-
Second floor	46.5300 (1d)	x	3.7000 (2d)	=	172.1610 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	625.6461	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

Effective ac	0.2809	0.2774	0.2740	0.2566	0.2532	0.2358	0.2358	0.2323	0.2427	0.2532	0.2601	0.2670	(25)

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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	
Window (Uw = 1.20)			36.1200	1.1450	41.3588			(27)

Door			4.8300	1.0000	4.8300	(26)
Heatloss Floor 1			77.1200	0.1000	7.7120	(28a)
External Wall 1	228.6900	40.9500	187.7400	0.1400	26.2836	(29a)
External Roof 1	12.0600		12.0600	0.1000	1.2060	(30)
External Roof 2	21.2000		21.2000	0.1000	2.1200	(30)
Total net area of external elements Aum(A, m2)			339.0700			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5104	(33)
Party Wall 1			56.2400	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		16.9535 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	100.4639 (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	57.9968	57.2806	56.5645	52.9836	52.2675	48.6866	48.6866	47.9704	50.1189	52.2675	53.6998	55.1321	(38)
Heat transfer coeff	158.4607	157.7445	157.0283	153.4475	152.7313	149.1505	149.1505	148.4343	150.5828	152.7313	154.1637	155.5960	(39)
Average = Sum(39)m / 12 =												153.2685	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8817	0.8777	0.8737	0.8538	0.8498	0.8299	0.8299	0.8259	0.8379	0.8498	0.8578	0.8658	(40)
HLP (average)												0.8528	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9754	(42)
Hot water usage for mixer showers	74.1083	72.9946	71.3717	68.2666	65.9751	63.4197	61.9672	63.5778	65.3433	68.0871	71.2589	73.8244	(42a)
Hot water usage for baths	31.9922	31.5171	30.8480	29.6143	28.6906	27.6663	27.1130	27.7774	28.5008	29.5969	30.8559	31.8841	(42b)
Hot water usage for other uses	45.1015	43.4615	41.8214	40.1814	38.5413	36.9013	36.9013	38.5413	40.1814	41.8214	43.4615	45.1015	(42c)
Average daily hot water use (litres/day)												138.9886	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.2021	147.9732	144.0412	138.0623	133.2070	127.9873	125.9815	129.8965	134.0255	139.5054	145.5763	150.8100	(44)
Energy conte	239.4671	210.7118	221.3859	189.0004	179.3223	157.3753	152.3637	160.8390	165.2669	189.3075	207.4001	236.1320	(45)
Energy content (annual)										Total = Sum(45)m =		2308.5720	
Distribution loss (46)m = 0.15 x (45)m	35.9201	31.6068	33.2079	28.3501	26.8983	23.6063	22.8545	24.1259	24.7900	28.3961	31.1100	35.4198	(46)

Water storage loss:		
Store volume		180.0000 (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		0.8736 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		0.8736 (55)

Total storage loss	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(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)
Combi 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	(61)
Total heat required for water heating calculated for each month	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764	(64)
										Total per year (kWh/year) = Sum(64)m =		2901.3371	(64)
12Total per year (kWh/year)												2901	(64)

Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	119.8984	106.4396	113.8864	101.8190	99.9002	91.3036	90.9365	93.7545	93.9276	103.2203	107.9369	118.7894	(65)

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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	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.3682	197.4791	178.3682	184.3138	178.3682	184.3138	178.3682	178.3682	184.3138	178.3682	184.3138	178.3682	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	351.3376	354.9834	345.7962	326.2376	301.5484	278.3440	262.8420	259.1963	268.3835	287.9421	312.6313	335.8357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	(71)
Water heating gains (Table 5)													

	161.1537	158.3923	153.0731	141.4153	134.2745	126.8106	122.2264	126.0141	130.4550	138.7369	149.9123	159.6632	(72)
Total internal gains	761.4913	781.4865	747.8692	722.5984	684.8228	657.1001	631.0684	631.2103	650.7840	675.6790	717.4892	744.4988	(73)

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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	
Northeast	19.7800	11.2829	0.6300	0.7000	0.7700	68.2057	(75)
Southeast	6.0800	36.7938	0.6300	0.7000	0.7700	68.3676	(77)
Southwest	10.2600	36.7938	0.6300	0.7000	0.7700	115.3704	(79)

Solar gains	251.9436	451.8083	678.3601	941.3855	1146.4946	1178.6998	1119.5398	960.3281	768.4707	515.5695	305.8961	212.9416	(83)
Total gains	1013.4349	1233.2949	1426.2293	1663.9839	1831.3174	1835.7999	1750.6082	1591.5384	1419.2548	1191.2485	1023.3853	957.4404	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	78.7612	79.1188	79.4796	81.3344	81.7158	83.6776	83.6776	84.0813	82.8817	81.7158	80.9565	80.2113	
alpha	6.2507	6.2746	6.2986	6.4223	6.4477	6.5785	6.5785	6.6054	6.5254	6.4477	6.3971	6.3474	
util living area	0.9985	0.9944	0.9797	0.9078	0.7358	0.5166	0.3745	0.4281	0.7037	0.9557	0.9954	0.9989	(86)
MIT	19.9750	20.1758	20.4475	20.7817	20.9540	20.9960	20.9996	20.9991	20.9746	20.7161	20.2917	19.9573	(87)
Th 2	20.1831	20.1865	20.1899	20.2069	20.2104	20.2275	20.2275	20.2309	20.2206	20.2104	20.2035	20.1967	(88)
util rest of house	0.9980	0.9927	0.9733	0.8827	0.6853	0.4558	0.3090	0.3570	0.6352	0.9378	0.9936	0.9986	(89)
MIT 2	18.9716	19.2305	19.5761	19.9915	20.1740	20.2253	20.2274	20.2306	20.2043	19.9265	19.3925	18.9593	(90)
Living area fraction									fLA = Living area / (4) =			0.1841	(91)
MIT	19.1564	19.4045	19.7365	20.1370	20.3176	20.3672	20.3695	20.3721	20.3461	20.0719	19.5581	19.1431	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1564	19.4045	19.7365	20.1370	20.3176	20.3672	20.3695	20.3721	20.3461	20.0719	19.5581	19.1431	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9904	0.9687	0.8802	0.6924	0.4669	0.3210	0.3701	0.6467	0.9340	0.9916	0.9979	(94)
Useful gains	1010.4547	1221.3941	1381.6253	1464.5842	1268.0608	857.0559	562.0116	589.0677	917.8851	1112.6420	1014.7810	955.4200	(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	2354.1513	2288.0113	2078.5117	1724.2886	1316.1839	860.1861	562.2287	589.5939	940.5608	1446.6510	1920.5789	2325.0857	(97)
Space heating kWh	999.7103	716.7668	518.4835	186.9871	35.8036	0.0000	0.0000	0.0000	0.0000	248.5027	652.1745	1019.0313	(98a)
Space heating requirement - total per year (kWh/year)												4377.4597	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	999.7103	716.7668	518.4835	186.9871	35.8036	0.0000	0.0000	0.0000	0.0000	248.5027	652.1745	1019.0313	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4377.4597	
Space heating per m2										(98c) / (4) =		24.3571	(99)

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 %)	219.3000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	999.7103	716.7668	518.4835	186.9871	35.8036	0.0000	0.0000	0.0000	0.0000	248.5027	652.1745	1019.0313	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	455.8642	326.8430	236.4266	85.2654	16.3263	0.0000	0.0000	0.0000	0.0000	113.3163	297.3892	464.6746	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764 (64)
Efficiency of water heater												190.4000 (216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (217)
Fuel for water heating, kWh/month												
	152.2120	134.5505	142.7155	124.8534	120.6233	108.2435	106.4643	110.9157	112.3883	125.8676	134.5171	150.4603 (219)
Space cooling fuel requirement												
(221)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 (221)
Pumps and Fa	74.5513	67.3367	74.5513	72.1464	74.5513	72.1464	74.5513	74.5513	72.1464	74.5513	72.1464	74.5513 (231)
Lighting	49.6296	39.8147	35.8487	26.2643	20.2873	16.5749	18.5068	24.0558	31.2461	40.9966	46.3055	51.0090 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)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 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)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 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)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 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)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 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)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 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)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 (235d)

Annual totals kWh/year	
Space heating fuel - main system 1	1996.1056 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	190.4000
Water heating fuel used	1523.8115 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.1500)	
mechanical ventilation fans (SFP = 1.1500)	877.7815 (230a)
Total electricity for the above, kWh/year	877.7815 (231)
Electricity for lighting (calculated in Appendix L)	400.5394 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4798.2380 (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	1996.1056	0.1569	313.1808	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1523.8115	0.1410	214.8462	(264)
Space and water heating			528.0270	(265)
Pumps, fans and electric keep-hot	877.7815	0.1387	121.7591	(267)
Energy for lighting	400.5394	0.1443	57.8102	(268)
Total CO2, kg/year			707.5963	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.9400	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1996.1056	1.5808	3155.5037	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1523.8115	1.5213	2318.2419	(278)
Space and water heating			5473.7457	(279)
Pumps, fans and electric keep-hot	877.7815	1.5128	1327.9078	(281)
Energy for lighting	400.5394	1.5338	614.3607	(282)
Total Primary energy kWh/year			7416.0142	(286)
Dwelling Primary energy Rate (DPER)			41.2600	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.1200 (1b)	x	3.7500 (2b)	=	289.2000 (1b)	-
First floor	56.0700 (1c)	x	2.9300 (2c)	=	164.2851 (1c)	-
Second floor	46.5300 (1d)	x	3.7000 (2d)	=	172.1610 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	625.6461	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0639	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3139	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2904	(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	0.3702	0.3630	0.3557	0.3194	0.3122	0.2759	0.2759	0.2686	0.2904	0.3122	0.3267	0.3412	(22b)
Effective ac	0.5685	0.5659	0.5633	0.5510	0.5487	0.5381	0.5381	0.5361	0.5422	0.5487	0.5534	0.5582	(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 Opaque door			4.8300	1.0000	4.8300			(26)
TER Opening Type (Uw = 1.20)			36.1200	1.1450	41.3588			(27)
Heatloss Floor 1			77.1200	0.1300	10.0256			(28a)
External Wall 1	228.6900	40.9500	187.7400	0.1800	33.7932			(29a)
External Roof 1	12.0600		12.0600	0.1100	1.3266			(30)
External Roof 2	21.2000		21.2000	0.1100	2.3320			(30)
Total net area of external elements Aum(A, m2)			339.0700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	93.6662			(33)
Party Wall 1			56.2400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	25.0000	0.0500	1.2500
E3 Sill	22.7000	0.0500	1.1350
E4 Jamb	50.0000	0.0500	2.5000
E5 Ground floor (normal)	25.2800	0.1600	4.0448
E6 Intermediate floor within a dwelling	42.0600	0.0000	0.0000
E16 Corner (normal)	20.7600	0.0900	1.8684
E18 Party wall between dwellings	20.7600	0.0600	1.2456

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.0438 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	105.7100 (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	117.3828	116.8333	116.2947	113.7647	113.2914	111.0879	111.0879	110.6799	111.9367	113.2914	114.2490	115.2501	(38)
Heat transfer coeff	223.0928	222.5433	222.0046	219.4747	219.0014	216.7979	216.7979	216.3899	217.6467	219.0014	219.9589	220.9600	(39)
Average = Sum(39)m / 12 =												219.4725	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2413	1.2383	1.2353	1.2212	1.2186	1.2063	1.2063	1.2040	1.2110	1.2186	1.2239	1.2295	(40)
HLP (average)												1.2212	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9754 (42)

Hot water usage for mixer showers

74.1083	72.9946	71.3717	68.2666	65.9751	63.4197	61.9672	63.5778	65.3433	68.0871	71.2589	73.8244 (42a)

Hot water usage for baths

31.9922	31.5171	30.8480	29.6143	28.6906	27.6663	27.1130	27.7774	28.5008	29.5969	30.8559	31.8841 (42b)

Hot water usage for other uses

45.1015	43.4615	41.8214	40.1814	38.5413	36.9013	36.9013	38.5413	40.1814	41.8214	43.4615	45.1015 (42c)

Average daily hot water use (litres/day) 138.9886 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.2021	147.9732	144.0412	138.0623	133.2070	127.9873	125.9815	129.8965	134.0255	139.5054	145.5763	150.8100	(44)
Energy conte	239.4671	210.7118	221.3859	189.0004	179.3223	157.3753	152.3637	160.8390	165.2669	189.3075	207.4001	236.1320	(45)

Energy content (annual) Total = Sum(45)m = 2308.5720

Distribution loss (46)m = 0.15 x (45)m

35.9201	31.6068	33.2079	28.3501	26.8983	23.6063	22.8545	24.1259	24.7900	28.3961	31.1100	35.4198 (46)

Water storage loss:

Store volume 180.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.5520 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.8381 (55)

Total storage loss

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (56)

If cylinder contains dedicated solar storage

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (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)
Combi 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	(61)

Total heat required for water heating calculated for each month

288.7098	255.1891	270.6286	236.6546	228.5650	205.0295	201.6063	210.0817	212.9211	238.5501	255.0543	285.3747 (62)

WWHRS	-33.8792	-29.9631	-31.3756	-25.9802	-24.2126	-20.7189	-19.4207	-20.6520	-21.4366	-25.2714	-28.6294	-33.2518	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

254.8306	225.2260	239.2530	210.6744	204.3523	184.3105	182.1856	189.4297	191.4845	213.2787	226.4249	252.1228 (64)

Total per year (kWh/year) = Sum(64)m = 2573.5731 (64)

12Total per year (kWh/year) 2574 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

119.0170	105.6435	113.0049	100.9660	99.0188	90.4506	90.0551	92.8731	93.0746	102.3389	107.0839	117.9080 (65)

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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	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

178.3682	197.4791	178.3682	184.3138	178.3682	184.3138	178.3682	178.3682	184.3138	178.3682	184.3138	178.3682 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

351.3376	354.9834	345.7962	326.2376	301.5484	278.3440	262.8420	259.1963	268.3835	287.9421	312.6313	335.8357 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772 (69)

Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179 (71)

Water heating gains (Table 5)

159.9690	157.2076	151.8884	140.2306	133.0898	125.6259	121.0417	124.8295	129.2703	137.5522	148.7276	158.4785 (72)

Total internal gains

760.3066	780.3018	746.6845	721.4137	683.6381	655.9154	629.8837	630.0256	649.5993	674.4943	716.3045	743.3142 (73)

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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	
Northeast	19.7800	11.2829	0.6300	0.7000	0.7700	68.2057	(75)
Southeast	6.0800	36.7938	0.6300	0.7000	0.7700	68.3676	(77)
Southwest	10.2600	36.7938	0.6300	0.7000	0.7700	115.3704	(79)

Solar gains	251.9436	451.8083	678.3601	941.3855	1146.4946	1178.6998	1119.5398	960.3281	768.4707	515.5695	305.8961	212.9416 (83)
Total gains	1012.2502	1232.1102	1425.0446	1662.7992	1830.1327	1834.6153	1749.4235	1590.3537	1418.0701	1190.0638	1022.2006	956.2557 (84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	55.9433	56.0815	56.2175	56.8656	56.9885	57.5677	57.5677	57.6762	57.3432	56.9885	56.7404	56.4833

alpha	4.7296	4.7388	4.7478	4.7910	4.7992	4.8378	4.8378	4.8451	4.8229	4.7992	4.7827	4.7656	
util living area	0.9985	0.9958	0.9883	0.9575	0.8686	0.6970	0.5317	0.6000	0.8511	0.9783	0.9965	0.9988	(86)
MIT	19.4071	19.6170	19.9365	20.3738	20.7367	20.9357	20.9860	20.9757	20.8261	20.3441	19.8000	19.3790	(87)
Th 2	19.8871	19.8895	19.8919	19.9031	19.9052	19.9150	19.9150	19.9168	19.9112	19.9052	19.9009	19.8965	(88)
util rest of house	0.9979	0.9944	0.9839	0.9411	0.8199	0.6017	0.4075	0.4714	0.7777	0.9671	0.9950	0.9984	(89)
MIT 2	18.0296	18.2996	18.7079	19.2608	19.6811	19.8783	19.9106	19.9082	19.7886	19.2347	18.5426	18.0001	(90)
Living area fraction										fLA = Living area / (4) =		0.1841	(91)
MIT	18.2832	18.5422	18.9341	19.4657	19.8755	20.0730	20.1086	20.1047	19.9796	19.4389	18.7741	18.2540	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2832	18.5422	18.9341	19.4657	19.8755	20.0730	20.1086	20.1047	19.9796	19.4389	18.7741	18.2540	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9917	0.9786	0.9327	0.8184	0.6166	0.4304	0.4949	0.7832	0.9603	0.9926	0.9975	(94)
Useful gains	1008.9100	1221.8515	1394.4990	1550.8822	1497.7172	1131.2952	752.9490	787.0144	1110.5738	1142.8616	1014.6502	953.8379	(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	3119.5620	3035.9722	2760.4287	2318.9095	1790.4366	1186.5357	760.6559	801.6698	1279.6822	1935.7411	2567.8265	3105.3764	(97)
Space heating kWh	1570.3251	1219.0891	1016.2517	552.9796	217.7832	0.0000	0.0000	0.0000	0.0000	589.9024	1118.2870	1600.7447	(98a)
Space heating requirement - total per year (kWh/year)												7885.3628	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1570.3251	1219.0891	1016.2517	552.9796	217.7832	0.0000	0.0000	0.0000	0.0000	589.9024	1118.2870	1600.7447	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7885.3628	
Space heating per m2											(98c) / (4) =	43.8758	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1570.3251	1219.0891	1016.2517	552.9796	217.7832	0.0000	0.0000	0.0000	0.0000	589.9024	1118.2870	1600.7447	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	1701.3273	1320.7899	1101.0311	599.1112	235.9515	0.0000	0.0000	0.0000	0.0000	639.1142	1211.5786	1734.2846	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	254.8306	225.2260	239.2530	210.6744	204.3523	184.3105	182.1856	189.4297	191.4845	213.2787	226.4249	252.1228	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4234	87.2653	86.9317	86.1205	84.2028	79.8000	79.8000	79.8000	79.8000	86.2179	87.1451	87.4578	(217)
Fuel for water heating, kWh/month	291.4902	258.0936	275.2196	244.6276	242.6907	230.9656	228.3028	237.3806	239.9555	247.3717	259.8252	288.2793	(219)
Space cooling fuel requirement													
(221)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	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	37.0614	29.7320	26.7704	19.6131	15.1498	12.3775	13.8201	17.9639	23.3333	30.6146	34.5791	38.0914	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-68.1546	-94.1110	-132.4802	-145.6890	-154.2659	-142.8151	-140.8514	-134.2156	-122.2883	-105.8505	-74.1404	-59.1407	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)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	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)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	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-44.7642	-93.3712	-184.2046	-274.7715	-361.6163	-362.8863	-358.8004	-304.7345	-224.4883	-133.1194	-59.6132	-35.4763	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)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	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)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	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)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	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												8543.1883	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3044.2024	(219)

Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	299.1067 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-3811.8492 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	8160.6482 (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	8543.1883	0.2100	1794.0695	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3044.2024	0.2100	639.2825	(264)
Space and water heating			2433.3520	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	299.1067	0.1443	43.1703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1374.0029	0.1351	-185.5875	
PV Unit electricity exported	-2437.8463	0.1261	-307.3822	
Total			-492.9697	(269)
Total CO2, kg/year			1995.4819	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1000	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	8543.1883	1.1300	9653.8028	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3044.2024	1.1300	3439.9487	(278)
Space and water heating			13093.7515	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	299.1067	1.5338	458.7798	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1374.0029	1.4992	-2059.9403	
PV Unit electricity exported	-2437.8463	0.4628	-1128.3229	
Total			-3188.2632	(283)
Total Primary energy kWh/year			10494.3689	(286)
Target Primary Energy Rate (TPER)			58.3900	(287)

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Full SAP Calculation Printout

elmhurst energy

Property Reference	Manor Lodge R	Issued on Date	13/01/2023
Assessment Reference	Be Lean_Manor Lodge_R	Prop Type Ref	Manor Lodge
Property			

SAP Rating	85 B	DER	10.43	TER	11.10
Environmental	89 B	% DER < TER			6.04
CO_2 Emissions (t/year)	1.59	DFEE	45.37	TFEE	48.90
Compliance Check	See BREL	% DFEE < TFEE			7.22
% DPER < TPER	-6.01	DPER	61.90	TPER	58.39

Assessor Details	Mr. Andy Love	Assessor ID	U860-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.1200 (1b)	x	3.7500 (2b)	=	289.2000 (1b)	-
First floor	56.0700 (1c)	x	2.9300 (2c)	=	164.2851 (1c)	-
Second floor	46.5300 (1d)	x	3.7000 (2d)	=	172.1610 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	625.6461	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

Effective ac	0.2809	0.2774	0.2740	0.2566	0.2532	0.2358	0.2358	0.2323	0.2427	0.2532	0.2601	0.2670	(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	
Window (Uw = 1.20)			36.1200	1.1450	41.3588			(27)

Door			4.8300	1.0000	4.8300	(26)
Heatloss Floor 1			77.1200	0.1000	7.7120	(28a)
External Wall 1	228.6900	40.9500	187.7400	0.1400	26.2836	(29a)
External Roof 1	12.0600		12.0600	0.1000	1.2060	(30)
External Roof 2	21.2000		21.2000	0.1000	2.1200	(30)
Total net area of external elements Aum(A, m2)			339.0700			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5104	(33)
Party Wall 1			56.2400	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		16.9535 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	100.4639 (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	57.9968	57.2806	56.5645	52.9836	52.2675	48.6866	48.6866	47.9704	50.1189	52.2675	53.6998	55.1321	(38)
Heat transfer coeff	158.4607	157.7445	157.0283	153.4475	152.7313	149.1505	149.1505	148.4343	150.5828	152.7313	154.1637	155.5960	(39)
Average = Sum(39)m / 12 =												153.2685	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8817	0.8777	0.8737	0.8538	0.8498	0.8299	0.8299	0.8259	0.8379	0.8498	0.8578	0.8658	(40)
HLP (average)												0.8528	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9754	(42)
Hot water usage for mixer showers	74.1083	72.9946	71.3717	68.2666	65.9751	63.4197	61.9672	63.5778	65.3433	68.0871	71.2589	73.8244	(42a)
Hot water usage for baths	31.9922	31.5171	30.8480	29.6143	28.6906	27.6663	27.1130	27.7774	28.5008	29.5969	30.8559	31.8841	(42b)
Hot water usage for other uses	45.1015	43.4615	41.8214	40.1814	38.5413	36.9013	36.9013	38.5413	40.1814	41.8214	43.4615	45.1015	(42c)
Average daily hot water use (litres/day)												138.9886	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.2021	147.9732	144.0412	138.0623	133.2070	127.9873	125.9815	129.8965	134.0255	139.5054	145.5763	150.8100	(44)
Energy conte	239.4671	210.7118	221.3859	189.0004	179.3223	157.3753	152.3637	160.8390	165.2669	189.3075	207.4001	236.1320	(45)
Energy content (annual)										Total = Sum(45)m =		2308.5720	
Distribution loss (46)m = 0.15 x (45)m	35.9201	31.6068	33.2079	28.3501	26.8983	23.6063	22.8545	24.1259	24.7900	28.3961	31.1100	35.4198	(46)

Water storage loss:		
Store volume		180.0000 (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		0.8736 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		0.8736 (55)

Total storage loss	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(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)
Combi 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	(61)
Total heat required for water heating calculated for each month	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764	(64)
										Total per year (kWh/year) = Sum(64)m =		2901.3371	(64)
12Total per year (kWh/year)												2901	(64)

Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	119.8984	106.4396	113.8864	101.8190	99.9002	91.3036	90.9365	93.7545	93.9276	103.2203	107.9369	118.7894	(65)

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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	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.3682	197.4791	178.3682	184.3138	178.3682	184.3138	178.3682	178.3682	184.3138	178.3682	184.3138	178.3682	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	351.3376	354.9834	345.7962	326.2376	301.5484	278.3440	262.8420	259.1963	268.3835	287.9421	312.6313	335.8357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	(71)
Water heating gains (Table 5)													

	161.1537	158.3923	153.0731	141.4153	134.2745	126.8106	122.2264	126.0141	130.4550	138.7369	149.9123	159.6632	(72)
Total internal gains	761.4913	781.4865	747.8692	722.5984	684.8228	657.1001	631.0684	631.2103	650.7840	675.6790	717.4892	744.4988	(73)

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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	
Northeast	19.7800	11.2829	0.6300	0.7000	0.7700	68.2057	(75)
Southeast	6.0800	36.7938	0.6300	0.7000	0.7700	68.3676	(77)
Southwest	10.2600	36.7938	0.6300	0.7000	0.7700	115.3704	(79)

Solar gains	251.9436	451.8083	678.3601	941.3855	1146.4946	1178.6998	1119.5398	960.3281	768.4707	515.5695	305.8961	212.9416	(83)
Total gains	1013.4349	1233.2949	1426.2293	1663.9839	1831.3174	1835.7999	1750.6082	1591.5384	1419.2548	1191.2485	1023.3853	957.4404	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	78.7612	79.1188	79.4796	81.3344	81.7158	83.6776	83.6776	84.0813	82.8817	81.7158	80.9565	80.2113	
alpha	6.2507	6.2746	6.2986	6.4223	6.4477	6.5785	6.5785	6.6054	6.5254	6.4477	6.3971	6.3474	
util living area	0.9985	0.9944	0.9797	0.9078	0.7358	0.5166	0.3745	0.4281	0.7037	0.9557	0.9954	0.9989	(86)
MIT	19.9750	20.1758	20.4475	20.7817	20.9540	20.9960	20.9996	20.9991	20.9746	20.7161	20.2917	19.9573	(87)
Th 2	20.1831	20.1865	20.1899	20.2069	20.2104	20.2275	20.2275	20.2309	20.2206	20.2104	20.2035	20.1967	(88)
util rest of house	0.9980	0.9927	0.9733	0.8827	0.6853	0.4558	0.3090	0.3570	0.6352	0.9378	0.9936	0.9986	(89)
MIT 2	18.9716	19.2305	19.5761	19.9915	20.1740	20.2253	20.2274	20.2306	20.2043	19.9265	19.3925	18.9593	(90)
Living area fraction									fLA = Living area / (4) =			0.1841	(91)
MIT	19.1564	19.4045	19.7365	20.1370	20.3176	20.3672	20.3695	20.3721	20.3461	20.0719	19.5581	19.1431	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0064	19.2545	19.5865	19.9870	20.1676	20.2172	20.2195	20.2221	20.1961	19.9219	19.4081	18.9931	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9898	0.9670	0.8747	0.6824	0.4549	0.3083	0.3562	0.6330	0.9296	0.9910	0.9978	(94)
Useful gains	1010.2835	1220.7361	1379.2280	1455.4268	1249.6719	835.1928	539.6935	566.9275	898.3527	1107.4017	1014.2087	955.3014	(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	2330.3822	2264.3496	2054.9575	1701.2715	1293.2742	837.8136	539.8561	567.3288	917.9733	1423.7413	1897.4543	2301.7463	(97)
Space heating kWh	982.1535	701.3083	502.7427	177.0081	32.4401	0.0000	0.0000	0.0000	0.0000	235.3566	635.9368	1001.7550	(98a)
Space heating requirement - total per year (kWh/year)												4268.7012	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	982.1535	701.3083	502.7427	177.0081	32.4401	0.0000	0.0000	0.0000	0.0000	235.3566	635.9368	1001.7550	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4268.7012	
Space heating per m2										(98c) / (4) =		23.7520	(99)

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 %)	89.5000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	982.1535	701.3083	502.7427	177.0081	32.4401	0.0000	0.0000	0.0000	0.0000	235.3566	635.9368	1001.7550	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	1097.3782	783.5847	561.7237	197.7744	36.2459	0.0000	0.0000	0.0000	0.0000	262.9683	710.5440	1119.2794	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764 (64)
Efficiency of water heater												89.5000 (216)
(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 (217)
Fuel for water heating, kWh/month												
	323.8118	286.2394	303.6093	265.6099	256.6109	230.2745	226.4895	235.9592	239.0919	267.7675	286.1682	320.0854 (219)
Space cooling fuel requirement												
(221)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 (221)
Pumps and Fa	81.8554	73.9339	81.8554	79.2149	81.8554	79.2149	81.8554	81.8554	79.2149	81.8554	79.2149	81.8554 (231)
Lighting	49.6296	39.8147	35.8487	26.2643	20.2873	16.5749	18.5068	24.0558	31.2461	40.9966	46.3055	51.0090 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)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 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)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 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)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 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)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 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)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 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)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 (235d)

Annual totals kWh/year

Space heating fuel - main system 1	4769.4986 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3241.7174 (219)
Space cooling fuel	0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.1500)

mechanical ventilation fans (SFP = 1.1500)	877.7815 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	963.7815 (231)
Electricity for lighting (calculated in Appendix L)	400.5394 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	9375.5369 (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	4769.4986	0.2100	1001.5947	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3241.7174	0.2100	680.7607	(264)
Space and water heating			1682.3554	(265)
Pumps, fans and electric keep-hot	963.7815	0.1387	133.6884	(267)
Energy for lighting	400.5394	0.1443	57.8102	(268)
Total CO2, kg/year			1873.8540	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.4300	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4769.4986	1.1300	5389.5334	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3241.7174	1.1300	3663.1407	(278)
Space and water heating			9052.6741	(279)
Pumps, fans and electric keep-hot	963.7815	1.5128	1458.0086	(281)
Energy for lighting	400.5394	1.5338	614.3607	(282)
Total Primary energy kWh/year			11125.0435	(286)
Dwelling Primary energy Rate (DPER)			61.9000	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.1200 (1b)	x	3.7500 (2b)	=	289.2000 (1b)	-
First floor	56.0700 (1c)	x	2.9300 (2c)	=	164.2851 (1c)	-
Second floor	46.5300 (1d)	x	3.7000 (2d)	=	172.1610 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	625.6461	(5)

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2. Ventilation rate
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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0639	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3139	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2904	(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	0.3702	0.3630	0.3557	0.3194	0.3122	0.2759	0.2759	0.2686	0.2904	0.3122	0.3267	0.3412	(22b)
Effective ac	0.5685	0.5659	0.5633	0.5510	0.5487	0.5381	0.5381	0.5361	0.5422	0.5487	0.5534	0.5582	(25)

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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 Opaque door			4.8300	1.0000	4.8300			(26)
TER Opening Type (Uw = 1.20)			36.1200	1.1450	41.3588			(27)
Heatloss Floor 1			77.1200	0.1300	10.0256			(28a)
External Wall 1	228.6900	40.9500	187.7400	0.1800	33.7932			(29a)
External Roof 1	12.0600		12.0600	0.1100	1.3266			(30)
External Roof 2	21.2000		21.2000	0.1100	2.3320			(30)
Total net area of external elements Aum(A, m2)			339.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.6662			(33)
Party Wall 1			56.2400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			250.0000 (35)
List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	25.0000	0.0500	1.2500
E3 Sill	22.7000	0.0500	1.1350
E4 Jamb	50.0000	0.0500	2.5000
E5 Ground floor (normal)	25.2800	0.1600	4.0448
E6 Intermediate floor within a dwelling	42.0600	0.0000	0.0000
E16 Corner (normal)	20.7600	0.0900	1.8684
E18 Party wall between dwellings	20.7600	0.0600	1.2456
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			12.0438 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =		105.7100 (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	117.3828	116.8333	116.2947	113.7647	113.2914	111.0879	111.0879	110.6799	111.9367	113.2914	114.2490	115.2501	(38)
Heat transfer coeff	223.0928	222.5433	222.0046	219.4747	219.0014	216.7979	216.7979	216.3899	217.6467	219.0014	219.9589	220.9600	(39)
Average = Sum(39)m / 12 =												219.4725	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2413	1.2383	1.2353	1.2212	1.2186	1.2063	1.2063	1.2040	1.2110	1.2186	1.2239	1.2295	(40)
HLP (average)												1.2212	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9754 (42)

Hot water usage for mixer showers

74.1083	72.9946	71.3717	68.2666	65.9751	63.4197	61.9672	63.5778	65.3433	68.0871	71.2589	73.8244 (42a)

Hot water usage for baths

31.9922	31.5171	30.8480	29.6143	28.6906	27.6663	27.1130	27.7774	28.5008	29.5969	30.8559	31.8841 (42b)

Hot water usage for other uses

45.1015	43.4615	41.8214	40.1814	38.5413	36.9013	36.9013	38.5413	40.1814	41.8214	43.4615	45.1015 (42c)

Average daily hot water use (litres/day) 138.9886 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	151.2021	147.9732	144.0412	138.0623	133.2070	127.9873	125.9815	129.8965	134.0255	139.5054	145.5763	150.8100	(44)
Energy conte	239.4671	210.7118	221.3859	189.0004	179.3223	157.3753	152.3637	160.8390	165.2669	189.3075	207.4001	236.1320	(45)
Energy content (annual)										Total = Sum(45)m =		2308.5720	
Distribution loss (46)m = 0.15 x (45)m													
	35.9201	31.6068	33.2079	28.3501	26.8983	23.6063	22.8545	24.1259	24.7900	28.3961	31.1100	35.4198	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi 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	(61)
Total heat required for water heating calculated for each month													
	288.7098	255.1891	270.6286	236.6546	228.5650	205.0295	201.6063	210.0817	212.9211	238.5501	255.0543	285.3747	(62)
WWHRS	-33.8792	-29.9631	-31.3756	-25.9802	-24.2126	-20.7189	-19.4207	-20.6520	-21.4366	-25.2714	-28.6294	-33.2518	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	254.8306	225.2260	239.2530	210.6744	204.3523	184.3105	182.1856	189.4297	191.4845	213.2787	226.4249	252.1228	(64)
										Total per year (kWh/year) = Sum(64)m =		2573.5731	(64)
12Total per year (kWh/year)												2574	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	119.0170	105.6435	113.0049	100.9660	99.0188	90.4506	90.0551	92.8731	93.0746	102.3389	107.0839	117.9080	(65)

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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	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	178.3682	197.4791	178.3682	184.3138	178.3682	184.3138	178.3682	178.3682	184.3138	178.3682	184.3138	178.3682	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	351.3376	354.9834	345.7962	326.2376	301.5484	278.3440	262.8420	259.1963	268.3835	287.9421	312.6313	335.8357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	(71)
Water heating gains (Table 5)													
	159.9690	157.2076	151.8884	140.2306	133.0898	125.6259	121.0417	124.8295	129.2703	137.5522	148.7276	158.4785	(72)
Total internal gains													
	760.3066	780.3018	746.6845	721.4137	683.6381	655.9154	629.8837	630.0256	649.5993	674.4943	716.3045	743.3142	(73)

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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	
Northeast	19.7800	11.2829	0.6300	0.7000	0.7700	68.2057	(75)
Southeast	6.0800	36.7938	0.6300	0.7000	0.7700	68.3676	(77)
Southwest	10.2600	36.7938	0.6300	0.7000	0.7700	115.3704	(79)

Solar gains	251.9436	451.8083	678.3601	941.3855	1146.4946	1178.6998	1119.5398	960.3281	768.4707	515.5695	305.8961	212.9416	(83)
Total gains	1012.2502	1232.1102	1425.0446	1662.7992	1830.1327	1834.6153	1749.4235	1590.3537	1418.0701	1190.0638	1022.2006	956.2557	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9433	56.0815	56.2175	56.8656	56.9885	57.5677	57.5677	57.6762	57.3432	56.9885	56.7404	56.4833	
alpha	4.7296	4.7388	4.7478	4.7910	4.7992	4.8378	4.8378	4.8451	4.8229	4.7992	4.7827	4.7656	
util living area													
	0.9985	0.9958	0.9883	0.9575	0.8686	0.6970	0.5317	0.6000	0.8511	0.9783	0.9965	0.9988	(86)
MIT	19.4071	19.6170	19.9365	20.3738	20.7367	20.9357	20.9860	20.9757	20.8261	20.3441	19.8000	19.3790	(87)
Th 2	19.8871	19.8895	19.8919	19.9031	19.9052	19.9150	19.9150	19.9168	19.9112	19.9052	19.9009	19.8965	(88)
util rest of house													
	0.9979	0.9944	0.9839	0.9411	0.8199	0.6017	0.4075	0.4714	0.7777	0.9671	0.9950	0.9984	(89)
MIT 2	18.0296	18.2996	18.7079	19.2608	19.6811	19.8783	19.9106	19.9082	19.7886	19.2347	18.5426	18.0001	(90)
Living area fraction										fLA = Living area / (4) =		0.1841	(91)
MIT	18.2832	18.5422	18.9341	19.4657	19.8755	20.0730	20.1086	20.1047	19.9796	19.4389	18.7741	18.2540	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2832	18.5422	18.9341	19.4657	19.8755	20.0730	20.1086	20.1047	19.9796	19.4389	18.7741	18.2540	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9917	0.9786	0.9327	0.8184	0.6166	0.4304	0.4949	0.7832	0.9603	0.9926	0.9975	(94)
Useful gains	1008.9100	1221.8515	1394.4990	1550.8822	1497.7172	1131.2952	752.9490	787.0144	1110.5738	1142.8616	1014.6502	953.8379	(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													
	3119.5620	3035.9722	2760.4287	2318.9095	1790.4366	1186.5357	760.6559	801.6698	1279.6822	1935.7411	2567.8265	3105.3764	(97)
Space heating kWh													
	1570.3251	1219.0891	1016.2517	552.9796	217.7832	0.0000	0.0000	0.0000	0.0000	589.9024	1118.2870	1600.7447	(98a)
Space heating requirement - total per year (kWh/year)												7885.3628	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1570.3251	1219.0891	1016.2517	552.9796	217.7832	0.0000	0.0000	0.0000	0.0000	589.9024	1118.2870	1600.7447	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7885.3628	
Space heating per m2											(98c) / (4) =	43.8758	(99)

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 %)	92.3000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1570.3251	1219.0891	1016.2517	552.9796	217.7832	0.0000	0.0000	0.0000	0.0000	589.9024	1118.2870	1600.7447	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	1701.3273	1320.7899	1101.0311	599.1112	235.9515	0.0000	0.0000	0.0000	0.0000	639.1142	1211.5786	1734.2846	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	254.8306	225.2260	239.2530	210.6744	204.3523	184.3105	182.1856	189.4297	191.4845	213.2787	226.4249	252.1228	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4234	87.2653	86.9317	86.1205	84.2028	79.8000	79.8000	79.8000	79.8000	86.2179	87.1451	87.4578	(217)
Fuel for water heating, kWh/month													
	291.4902	258.0936	275.2196	244.6276	242.6907	230.9656	228.3028	237.3806	239.9555	247.3717	259.8252	288.2793	(219)
Space cooling fuel requirement													
(221)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	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	37.0614	29.7320	26.7704	19.6131	15.1498	12.3775	13.8201	17.9639	23.3333	30.6146	34.5791	38.0914	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-68.1546	-94.1110	-132.4802	-145.6890	-154.2659	-142.8151	-140.8514	-134.2156	-122.2883	-105.8505	-74.1404	-59.1407	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)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	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)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	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-44.7642	-93.3712	-184.2046	-274.7715	-361.6163	-362.8863	-358.8004	-304.7345	-224.4883	-133.1194	-59.6132	-35.4763	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)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	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)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	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)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	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												8543.1883	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)

Efficiency of water heater	79.8000
Water heating fuel used	3044.2024 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	299.1067 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-3811.8492 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	8160.6482 (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	8543.1883	0.2100	1794.0695	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3044.2024	0.2100	639.2825	(264)
Space and water heating			2433.3520	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	299.1067	0.1443	43.1703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1374.0029	0.1351	-185.5875	
PV Unit electricity exported	-2437.8463	0.1261	-307.3822	
Total			-492.9697	(269)
Total CO2, kg/year			1995.4819	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1000	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	8543.1883	1.1300	9653.8028	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3044.2024	1.1300	3439.9487	(278)
Space and water heating			13093.7515	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	299.1067	1.5338	458.7798	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1374.0029	1.4992	-2059.9403	
PV Unit electricity exported	-2437.8463	0.4628	-1128.3229	
Total			-3188.2632	(283)
Total Primary energy kWh/year			10494.3689	(286)
Target Primary Energy Rate (TPER)			58.3900	(287)

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Full SAP Calculation Printout

Property Reference	Manor Lodge L	Issued on Date	13/01/2023
Assessment Reference	Be Green_Manor Lodge	Prop Type Ref	Manor Lodge
Property			

SAP Rating	80 C	DER	4.03	TER	11.43
Environmental	96 A	% DER < TER			64.74
CO_2 Emissions (t/year)	0.64	DFEE	46.80	TFEE	50.35
Compliance Check	See BREL	% DFEE < TFEE			7.03
% DPER < TPER	29.81	DPER	42.23	TPER	60.16

Assessor Details	Mr. Andy Love	Assessor ID	U860-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.1200 (1b)	x	3.7500 (2b)	=	289.2000 (1b)	-
First floor	56.0700 (1c)	x	2.9300 (2c)	=	164.2851 (1c)	-
Second floor	46.5300 (1d)	x	3.7000 (2d)	=	172.1610 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	625.6461	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

Effective ac	0.2809	0.2774	0.2740	0.2566	0.2532	0.2358	0.2358	0.2323	0.2427	0.2532	0.2601	0.2670	(25)

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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	
Window (Uw = 1.20)			36.1200	1.1450	41.3588			(27)

Door			4.8300	1.0000	4.8300	(26)
Heatloss Floor 1			77.1200	0.1000	7.7120	(28a)
External Wall 1	228.6900	40.9500	187.7400	0.1400	26.2836	(29a)
External Roof 1	12.0600		12.0600	0.1000	1.2060	(30)
External Roof 2	21.2000		21.2000	0.1000	2.1200	(30)
Total net area of external elements Aum(A, m2)			339.0700			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.5104	(33)
Party Wall 1			56.2400	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		16.9535 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	100.4639 (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	57.9968	57.2806	56.5645	52.9836	52.2675	48.6866	48.6866	47.9704	50.1189	52.2675	53.6998	55.1321	(38)
Heat transfer coeff	158.4607	157.7445	157.0283	153.4475	152.7313	149.1505	149.1505	148.4343	150.5828	152.7313	154.1637	155.5960	(39)
Average = Sum(39)m / 12 =												153.2685	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8817	0.8777	0.8737	0.8538	0.8498	0.8299	0.8299	0.8259	0.8379	0.8498	0.8578	0.8658	(40)
HLP (average)												0.8528	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9754	(42)
Hot water usage for mixer showers	74.1083	72.9946	71.3717	68.2666	65.9751	63.4197	61.9672	63.5778	65.3433	68.0871	71.2589	73.8244	(42a)
Hot water usage for baths	31.9922	31.5171	30.8480	29.6143	28.6906	27.6663	27.1130	27.7774	28.5008	29.5969	30.8559	31.8841	(42b)
Hot water usage for other uses	45.1015	43.4615	41.8214	40.1814	38.5413	36.9013	36.9013	38.5413	40.1814	41.8214	43.4615	45.1015	(42c)
Average daily hot water use (litres/day)												138.9886	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.2021	147.9732	144.0412	138.0623	133.2070	127.9873	125.9815	129.8965	134.0255	139.5054	145.5763	150.8100	(44)
Energy conte	239.4671	210.7118	221.3859	189.0004	179.3223	157.3753	152.3637	160.8390	165.2669	189.3075	207.4001	236.1320	(45)
Energy content (annual)										Total = Sum(45)m =		2308.5720	
Distribution loss (46)m = 0.15 x (45)m	35.9201	31.6068	33.2079	28.3501	26.8983	23.6063	22.8545	24.1259	24.7900	28.3961	31.1100	35.4198	(46)

Water storage loss:		
Store volume		180.0000 (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		0.8736 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		0.8736 (55)

Total storage loss	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(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)
Combi 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	(61)
Total heat required for water heating calculated for each month	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764	(64)
										Total per year (kWh/year) = Sum(64)m =		2901.3371	(64)
12Total per year (kWh/year)												2901	(64)

Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	119.8984	106.4396	113.8864	101.8190	99.9002	91.3036	90.9365	93.7545	93.9276	103.2203	107.9369	118.7894	(65)

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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	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.3682	197.4791	178.3682	184.3138	178.3682	184.3138	178.3682	178.3682	184.3138	178.3682	184.3138	178.3682	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	351.3376	354.9834	345.7962	326.2376	301.5484	278.3440	262.8420	259.1963	268.3835	287.9421	312.6313	335.8357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	(71)
Water heating gains (Table 5)													

	161.1537	158.3923	153.0731	141.4153	134.2745	126.8106	122.2264	126.0141	130.4550	138.7369	149.9123	159.6632 (72)
Total internal gains	761.4913	781.4865	747.8692	722.5984	684.8228	657.1001	631.0684	631.2103	650.7840	675.6790	717.4892	744.4988 (73)

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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
Northeast	19.7800	11.2829	0.6300	0.7000	0.7700	68.2057 (75)
Southwest	10.2600	36.7938	0.6300	0.7000	0.7700	115.3704 (79)
Northwest	6.0800	11.2829	0.6300	0.7000	0.7700	20.9651 (81)

Solar gains	204.5412	378.0281	595.9079	870.2270	1095.0901	1140.1147	1077.1595	901.3074	689.6281	439.0140	250.3870	171.5543 (83)
Total gains	966.0325	1159.5147	1343.7770	1592.8254	1779.9128	1797.2148	1708.2279	1532.5177	1340.4121	1114.6930	967.8762	916.0532 (84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	78.7612	79.1188	79.4796	81.3344	81.7158	83.6776	83.6776	84.0813	82.8817	81.7158	80.9565	80.2113	
alpha	6.2507	6.2746	6.2986	6.4223	6.4477	6.5785	6.5785	6.6054	6.5254	6.4477	6.3971	6.3474	
util living area	0.9988	0.9960	0.9849	0.9219	0.7518	0.5272	0.3837	0.4444	0.7364	0.9673	0.9966	0.9992	(86)
MIT	19.9456	20.1309	20.4012	20.7551	20.9481	20.9955	20.9995	20.9988	20.9671	20.6781	20.2577	19.9314	(87)
Th 2	20.1831	20.1865	20.1899	20.2069	20.2104	20.2275	20.2275	20.2309	20.2206	20.2104	20.2035	20.1967	(88)
util rest of house	0.9984	0.9947	0.9799	0.8993	0.7015	0.4654	0.3166	0.3707	0.6678	0.9532	0.9953	0.9989	(89)
MIT 2	18.9339	19.1734	19.5186	19.9621	20.1690	20.2251	20.2273	20.2305	20.1991	19.8822	19.3492	18.9262	(90)
Living area fraction									fLA = Living area / (4) =			0.1841	(91)
MIT	19.1202	19.3497	19.6811	20.1081	20.3124	20.3669	20.3695	20.3720	20.3405	20.0287	19.5165	19.1113	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1202	19.3497	19.6811	20.1081	20.3124	20.3669	20.3695	20.3720	20.3405	20.0287	19.5165	19.1113	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9929	0.9759	0.8961	0.7084	0.4766	0.3290	0.3843	0.6789	0.9491	0.9937	0.9983	(94)
Useful gains	963.8239	1151.2545	1311.3672	1427.2971	1260.8065	856.6063	561.9721	588.9173	909.9823	1057.9656	961.7371	914.5309	(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	2348.4183	2279.3635	2069.8066	1719.8593	1315.3865	860.1386	562.2243	589.5774	939.7085	1440.0630	1914.1700	2320.1401	(97)
Space heating kWh	1030.1382	758.0892	564.2789	210.6448	40.6075	0.0000	0.0000	0.0000	0.0000	284.2805	685.7516	1045.7732	(98a)
Space heating requirement - total per year (kWh/year)												4619.5640	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1030.1382	758.0892	564.2789	210.6448	40.6075	0.0000	0.0000	0.0000	0.0000	284.2805	685.7516	1045.7732	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4619.5640	
Space heating per m2											(98c) / (4) =	25.7042	(99)

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 %)	219.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1030.1382	758.0892	564.2789	210.6448	40.6075	0.0000	0.0000	0.0000	0.0000	284.2805	685.7516	1045.7732	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	469.7393	345.6859	257.3091	96.0532	18.5169	0.0000	0.0000	0.0000	0.0000	129.6309	312.7002	476.8688	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	289.8116	256.1842	271.7303	237.7209	229.6667	206.0957	202.7081	211.1835	213.9873	239.6519	256.1205	286.4764 (64)
Efficiency of water heater												190.4000 (216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (217)
Fuel for water heating, kWh/month												
	152.2120	134.5505	142.7155	124.8534	120.6233	108.2435	106.4643	110.9157	112.3883	125.8676	134.5171	150.4603 (219)
Space cooling fuel requirement												
(221)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 (221)
Pumps and Fa	74.5513	67.3367	74.5513	72.1464	74.5513	72.1464	74.5513	74.5513	72.1464	74.5513	72.1464	74.5513 (231)
Lighting	49.6296	39.8147	35.8487	26.2643	20.2873	16.5749	18.5068	24.0558	31.2461	40.9966	46.3055	51.0090 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)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 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)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 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)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 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)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 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)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 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)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 (235d)

Annual totals kWh/year	
Space heating fuel - main system 1	2106.5043 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	190.4000
Water heating fuel used	1523.8115 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.1500)	
mechanical ventilation fans (SFP = 1.1500)	877.7815 (230a)
Total electricity for the above, kWh/year	877.7815 (231)
Electricity for lighting (calculated in Appendix L)	400.5394 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4908.6367 (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	2106.5043	0.1567	330.0025	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1523.8115	0.1410	214.8462	(264)
Space and water heating			544.8487	(265)
Pumps, fans and electric keep-hot	877.7815	0.1387	121.7591	(267)
Energy for lighting	400.5394	0.1443	57.8102	(268)
Total CO2, kg/year			724.4181	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.0300	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2106.5043	1.5800	3328.2061	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1523.8115	1.5213	2318.2419	(278)
Space and water heating			5646.4480	(279)
Pumps, fans and electric keep-hot	877.7815	1.5128	1327.9078	(281)
Energy for lighting	400.5394	1.5338	614.3607	(282)
Total Primary energy kWh/year			7588.7166	(286)
Dwelling Primary energy Rate (DPER)			42.2300	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	77.1200 (1b)	x	3.7500 (2b)	=	289.2000 (1b)	-
First floor	56.0700 (1c)	x	2.9300 (2c)	=	164.2851 (1c)	-
Second floor	46.5300 (1d)	x	3.7000 (2d)	=	172.1610 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	625.6461	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0639	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3139	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2904	(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	0.3702	0.3630	0.3557	0.3194	0.3122	0.2759	0.2759	0.2686	0.2904	0.3122	0.3267	0.3412	(22b)
Effective ac	0.5685	0.5659	0.5633	0.5510	0.5487	0.5381	0.5381	0.5361	0.5422	0.5487	0.5534	0.5582	(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 Opaque door			4.8300	1.0000	4.8300			(26)
TER Opening Type (Uw = 1.20)			36.1200	1.1450	41.3588			(27)
Heatloss Floor 1			77.1200	0.1300	10.0256			(28a)
External Wall 1	228.6900	40.9500	187.7400	0.1800	33.7932			(29a)
External Roof 1	12.0600		12.0600	0.1100	1.3266			(30)
External Roof 2	21.2000		21.2000	0.1100	2.3320			(30)
Total net area of external elements Aum(A, m2)			339.0700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	93.6662			(33)
Party Wall 1			56.2400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	25.0000	0.0500	1.2500
E3 Sill	22.7000	0.0500	1.1350
E4 Jamb	50.0000	0.0500	2.5000
E5 Ground floor (normal)	25.2800	0.1600	4.0448
E6 Intermediate floor within a dwelling	42.0600	0.0000	0.0000
E16 Corner (normal)	20.7600	0.0900	1.8684
E18 Party wall between dwellings	20.7600	0.0600	1.2456

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.0438 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	105.7100 (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	117.3828	116.8333	116.2947	113.7647	113.2914	111.0879	111.0879	110.6799	111.9367	113.2914	114.2490	115.2501	(38)
Heat transfer coeff	223.0928	222.5433	222.0046	219.4747	219.0014	216.7979	216.7979	216.3899	217.6467	219.0014	219.9589	220.9600	(39)
Average = Sum(39)m / 12 =												219.4725	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2413	1.2383	1.2353	1.2212	1.2186	1.2063	1.2063	1.2040	1.2110	1.2186	1.2239	1.2295	(40)
HLP (average)												1.2212	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9754 (42)

Hot water usage for mixer showers

74.1083	72.9946	71.3717	68.2666	65.9751	63.4197	61.9672	63.5778	65.3433	68.0871	71.2589	73.8244 (42a)

Hot water usage for baths

31.9922	31.5171	30.8480	29.6143	28.6906	27.6663	27.1130	27.7774	28.5008	29.5969	30.8559	31.8841 (42b)

Hot water usage for other uses

45.1015	43.4615	41.8214	40.1814	38.5413	36.9013	36.9013	38.5413	40.1814	41.8214	43.4615	45.1015 (42c)

Average daily hot water use (litres/day) 138.9886 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.2021	147.9732	144.0412	138.0623	133.2070	127.9873	125.9815	129.8965	134.0255	139.5054	145.5763	150.8100	(44)
Energy conte	239.4671	210.7118	221.3859	189.0004	179.3223	157.3753	152.3637	160.8390	165.2669	189.3075	207.4001	236.1320	(45)

Energy content (annual) Total = Sum(45)m = 2308.5720

Distribution loss (46)m = 0.15 x (45)m

35.9201	31.6068	33.2079	28.3501	26.8983	23.6063	22.8545	24.1259	24.7900	28.3961	31.1100	35.4198 (46)

Water storage loss:

Store volume 180.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.5520 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.8381 (55)

Total storage loss

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (56)

If cylinder contains dedicated solar storage

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (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)
Combi 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 (61)

Total heat required for water heating calculated for each month

288.7098	255.1891	270.6286	236.6546	228.5650	205.0295	201.6063	210.0817	212.9211	238.5501	255.0543	285.3747 (62)
WWHRS -33.8792	-29.9631	-31.3756	-25.9802	-24.2126	-20.7189	-19.4207	-20.6520	-21.4366	-25.2714	-28.6294	-33.2518 (63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
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 (63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)

Output from w/h

254.8306	225.2260	239.2530	210.6744	204.3523	184.3105	182.1856	189.4297	191.4845	213.2787	226.4249	252.1228 (64)

Total per year (kWh/year) = Sum(64)m = 2573.5731 (64)

12Total per year (kWh/year) 2574 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

119.0170	105.6435	113.0049	100.9660	99.0188	90.4506	90.0551	92.8731	93.0746	102.3389	107.0839	117.9080 (65)

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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	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	148.7723	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

178.3682	197.4791	178.3682	184.3138	178.3682	184.3138	178.3682	178.3682	184.3138	178.3682	184.3138	178.3682 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

351.3376	354.9834	345.7962	326.2376	301.5484	278.3440	262.8420	259.1963	268.3835	287.9421	312.6313	335.8357 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772	37.8772 (69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179	-119.0179 (71)

Water heating gains (Table 5)

159.9690	157.2076	151.8884	140.2306	133.0898	125.6259	121.0417	124.8295	129.2703	137.5522	148.7276	158.4785 (72)

Total internal gains

760.3066	780.3018	746.6845	721.4137	683.6381	655.9154	629.8837	630.0256	649.5993	674.4943	716.3045	743.3142 (73)

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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	
Northeast	19.7800	11.2829	0.6300	0.7000	0.7700	68.2057	(75)
Southwest	10.2600	36.7938	0.6300	0.7000	0.7700	115.3704	(79)
Northwest	6.0800	11.2829	0.6300	0.7000	0.7700	20.9651	(81)

Solar gains	204.5412	378.0281	595.9079	870.2270	1095.0901	1140.1147	1077.1595	901.3074	689.6281	439.0140	250.3870	171.5543	(83)
Total gains	964.8478	1158.3300	1342.5923	1591.6407	1778.7282	1796.0301	1707.0432	1531.3330	1339.2274	1113.5083	966.6915	914.8685	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	55.9433	56.0815	56.2175	56.8656	56.9885	57.5677	57.5677	57.6762	57.3432	56.9885	56.7404	56.4833

alpha	4.7296	4.7388	4.7478	4.7910	4.7992	4.8378	4.8378	4.8451	4.8229	4.7992	4.7827	4.7656	
util living area	0.9988	0.9968	0.9908	0.9636	0.8785	0.7078	0.5435	0.6193	0.8720	0.9833	0.9972	0.9990	(86)
MIT	19.3795	19.5745	19.8906	20.3394	20.7207	20.9313	20.9846	20.9722	20.8030	20.3032	19.7679	19.3548	(87)
Th 2	19.8871	19.8895	19.8919	19.9031	19.9052	19.9150	19.9150	19.9168	19.9112	19.9052	19.9009	19.8965	(88)
util rest of house	0.9983	0.9956	0.9873	0.9492	0.8318	0.6125	0.4173	0.4884	0.8037	0.9743	0.9960	0.9987	(89)
MIT 2	17.9943	18.2455	18.6502	19.2199	19.6652	19.8754	19.9101	19.9068	19.7686	19.1848	18.5017	17.9692	(90)
Living area fraction										fLA = Living area / (4) =		0.1841	(91)
MIT	18.2493	18.4902	18.8786	19.4261	19.8595	20.0699	20.1080	20.1030	19.9590	19.3907	18.7348	18.2243	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2493	18.4902	18.8786	19.4261	19.8595	20.0699	20.1080	20.1030	19.9590	19.3907	18.7348	18.2243	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9934	0.9827	0.9410	0.8295	0.6272	0.4405	0.5122	0.8074	0.9682	0.9941	0.9979	(94)
Useful gains	962.2268	1150.7313	1319.3177	1497.7119	1475.3922	1126.5198	752.0041	784.3340	1081.2433	1078.1092	960.9551	912.9417	(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	3111.9973	3024.4020	2748.0974	2310.2038	1786.9444	1185.8524	760.5184	801.2852	1275.2018	1925.1783	2559.1791	3098.8061	(97)
Space heating kWh	1599.4292	1259.1067	1063.0121	584.9941	231.7948	0.0000	0.0000	0.0000	0.0000	630.2194	1150.7213	1626.2831	(98a)
Space heating requirement - total per year (kWh/year)												8145.5607	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1599.4292	1259.1067	1063.0121	584.9941	231.7948	0.0000	0.0000	0.0000	0.0000	630.2194	1150.7213	1626.2831	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8145.5607	
Space heating per m2											(98c) / (4) =	45.3236	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1599.4292	1259.1067	1063.0121	584.9941	231.7948	0.0000	0.0000	0.0000	0.0000	630.2194	1150.7213	1626.2831	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	1732.8594	1364.1459	1151.6924	633.7965	251.1320	0.0000	0.0000	0.0000	0.0000	682.7946	1246.7186	1761.9535	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	254.8306	225.2260	239.2530	210.6744	204.3523	184.3105	182.1856	189.4297	191.4845	213.2787	226.4249	252.1228	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4446	87.3059	86.9974	86.2251	84.3431	79.8000	79.8000	79.8000	79.8000	86.3379	87.1833	87.4758	(217)
Fuel for water heating, kWh/month	291.4193	257.9733	275.0117	244.3306	242.2870	230.9656	228.3028	237.3806	239.9555	247.0279	259.7112	288.2200	(219)
Space cooling fuel requirement													
(221)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	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	37.0614	29.7320	26.7704	19.6131	15.1498	12.3775	13.8201	17.9639	23.3333	30.6146	34.5791	38.0914	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-68.1546	-94.1110	-132.4802	-145.6890	-154.2659	-142.8151	-140.8514	-134.2156	-122.2883	-105.8505	-74.1404	-59.1407	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)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	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)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	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-44.7642	-93.3712	-184.2046	-274.7715	-361.6163	-362.8863	-358.8004	-304.7345	-224.4883	-133.1194	-59.6132	-35.4763	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)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	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)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	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)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	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												8825.0929	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3042.5856	(219)

Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	299.1067 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-3811.8492 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	8440.9359 (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	8825.0929	0.2100	1853.2695	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3042.5856	0.2100	638.9430	(264)
Space and water heating			2492.2125	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	299.1067	0.1443	43.1703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1374.0029	0.1351	-185.5875	
PV Unit electricity exported	-2437.8463	0.1261	-307.3822	
Total			-492.9697	(269)
Total CO2, kg/year			2054.3423	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.4300	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	8825.0929	1.1300	9972.3549	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3042.5856	1.1300	3438.1217	(278)
Space and water heating			13410.4766	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	299.1067	1.5338	458.7798	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1374.0029	1.4992	-2059.9403	
PV Unit electricity exported	-2437.8463	0.4628	-1128.3229	
Total			-3188.2632	(283)
Total Primary energy kWh/year			10811.0941	(286)
Target Primary Energy Rate (TPER)			60.1600	(287)

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