LOVE DESIGN STUDIO

March 2025

Manor Lodge

Energy and Sustainability Statement

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March 2025
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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 Proposed Development 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 Proposed Development 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 Proposed Development is currently demonstrating a combined on-site regulated **CO_2 reduction of 61%** (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.

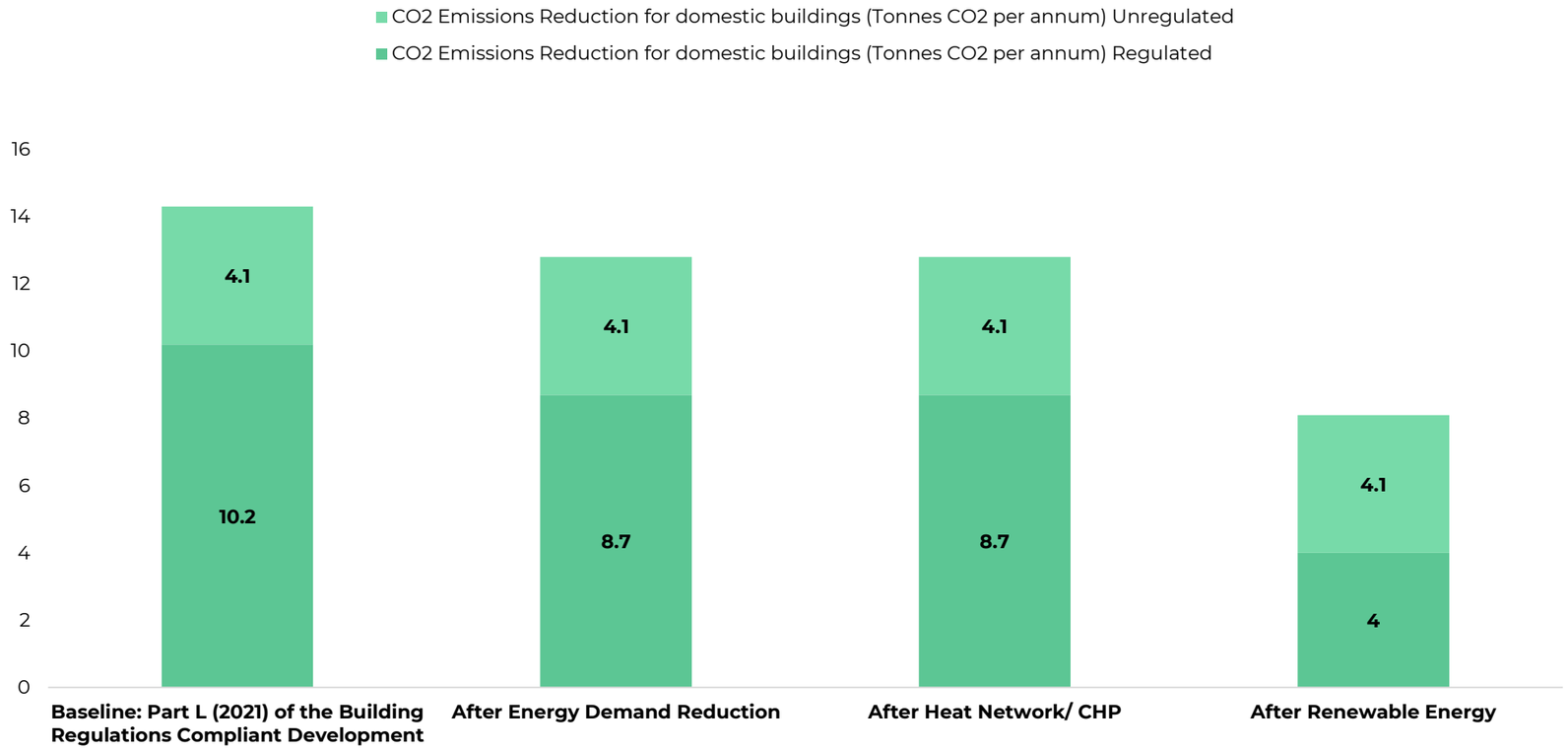

Figure 1: Total site-wide savings at each stage of the energy hierarchy

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	1.5	15%
Savings from heat network / CHP	0	0%
Savings from renewable energy	4.7	46%
Cumulative savings	**6.2**	**61%**

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 Proposed Development and demonstrate the alignment of the proposed energy strategy with relevant national, regional, and local planning policy requirements.

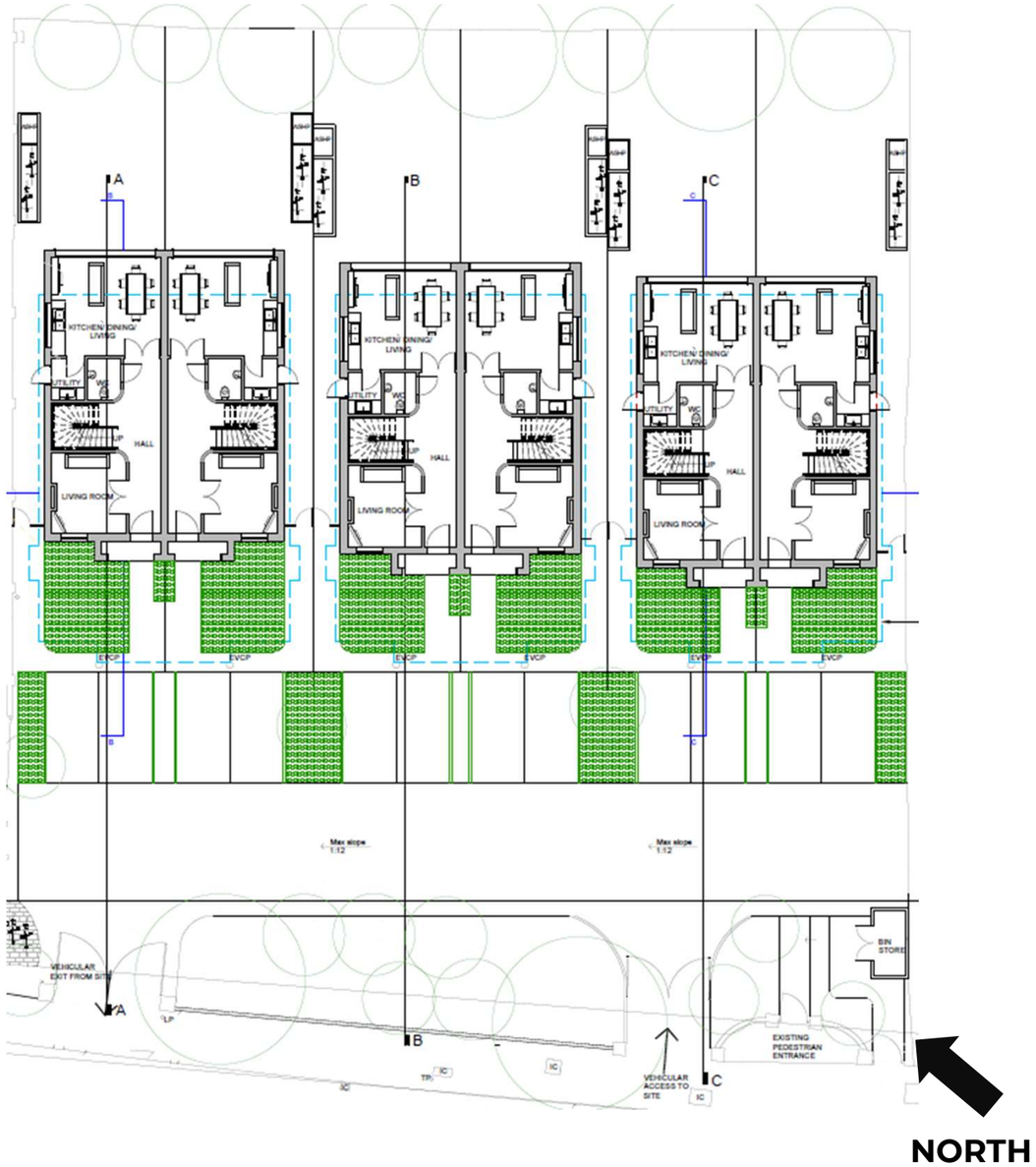

FIgure 2: Proposed site plan (provided by Seabrook Architects)

Planning Policy - National

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. 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, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating and drought from rising temperatures. Policies should support appropriate measures to ensure the future health and 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.

The need to mitigate and adapt to climate change should also be considered in preparing and assessing planning applications, taking into account the full range of potential climate change impacts.

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 incorporating green infrastructure and sustainable drainage systems; and*
- *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, and their future re-powering and life extension, while ensuring that adverse impacts are addressed appropriately (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.*

- Section 14, paragraphs 162-165 of the National Planning Policy Framework February 2025

Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

- *an economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;*
- *a social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering well-designed beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and*
- *an environmental objective – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimizing waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.*

- Section 2, paragraph 8 of the National Planning Policy Framework February 2025

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 Proposed Development has followed the energy hierarchy written in the key policy below.

POLICY SI 2 - MINIMISING GREENHOUSE GAS EMISSIONS

Although Policy SI 2 pertains to major developments, the Proposed Development is classified as a minor development and complies with 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.

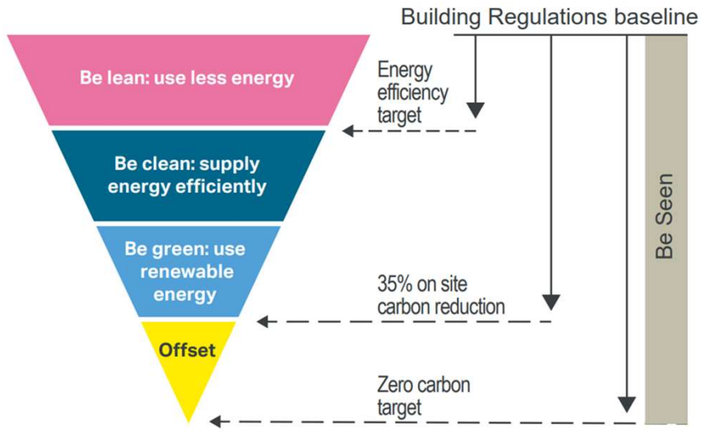

Figure 3: The energy hierarchy proposed in the London Plan 2021.

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 Proposed Development 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 Proposed Development 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 Proposed Development 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 Proposed Development 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 Proposed Development, 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 Proposed Development are based on information received from Seabrook Architects on 20th March 2025.
- 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 Proposed Development 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 14.9% 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: Proposed Debekionebt 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 Proposed Development

	TFEE (kWh/m²/yr)	**DFEE (kWh/m²/yr)**	**Improvement (%)**
Development total	45.5	38.7	14.9

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.

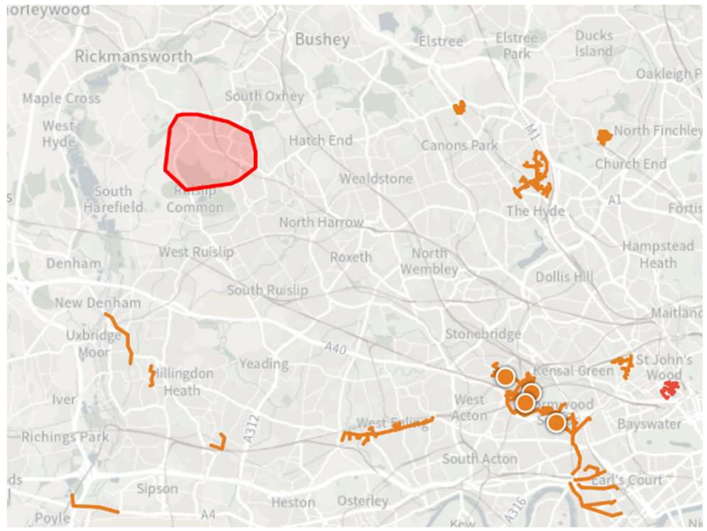

Figure 4: Site postcode HA6 (red), in relation to proposed heat networks (orange)

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 Proposed Development 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 Proposed Development

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 Proposed Development 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.

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 Proposed Development meets a combined on-site regulated **CO_2 reduction of 61%** (Part L 2021 Baseline).

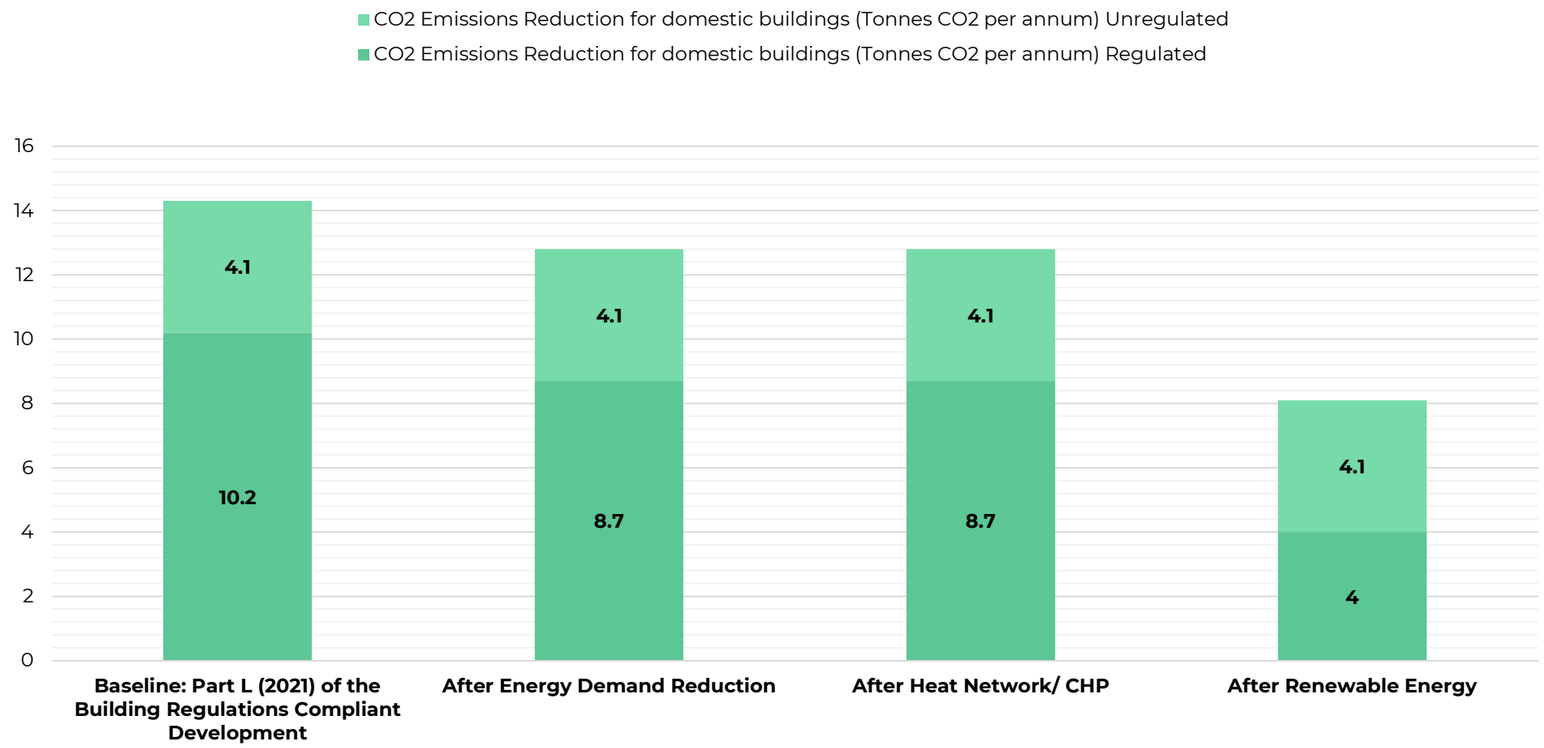

Figure 5: Total site-wide savings at each stage of the energy hierarchy

Table 9: Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings (SAP 10)

	Carbon dioxide emissions from domestic buildings (tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2021 of the Building Regulations Compliant Development	10.2	4.1
After energy demand reduction	8.7	
After heat network / CHP	8.7	
After renewable energy	4.0	

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	1.5	15%
Savings from heat network / CHP	0	0%
Savings from renewable energy	4.7	46%
Cumulative savings	**6.2**	**61%**

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

	TFEE (kWh/m²)	DFEE (kWh/m²)	Improvement (%)
Development total	45.5	38.7	14.9%

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 Proposed Development meets a combined on-site reduction of **5.4% 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	56.8	-
Proposed Development	46.0	5.4%

Section Three

3 Sustainability

Sustainability and Climate Change Appraisal

The sustainability credentials of the Proposed Development 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 Proposed Development's sustainability credentials and summarised the Proposed Development's aspirations against each category

Energy Display Devices

The Proposed Development 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 Proposed Development 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 Proposed Development 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 Proposed Development 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 Proposed Development 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 Proposed Development. 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' Proposed Development
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).

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.

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.

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 Proposed Development 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 Proposed Development 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 Proposed Development 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 Proposed Development 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 Proposed Development, 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 Proposed Development 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 Proposed Development 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 Proposed Development 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 Proposed Development is currently demonstrating a combined on-site regulated **CO_2 reduction of 61%** (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.

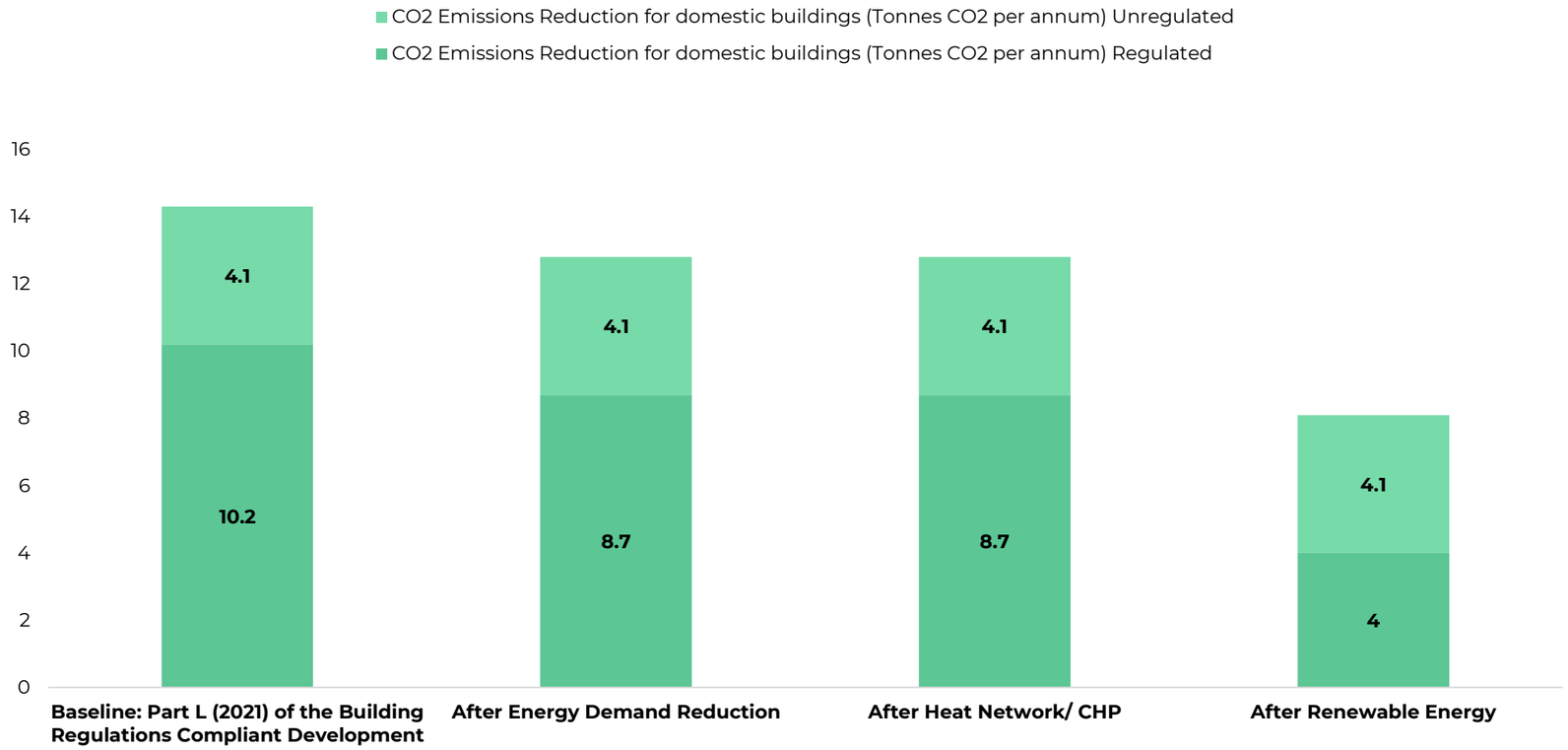

Figure 6: Total site-wide savings at each stage of the energy hierarchy

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	1.5	15%
Savings from heat network / CHP	0	-
Savings from renewable energy	4.7	46%
Cumulative savings	**6.2**	**61%**

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 Proposed Development 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	Titon CME2 Q Plus A	-	Mechanical Ventilation with Heat Recovery
System Assumptions			
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	Be_Green_Manor_Lodge_East	**Issued on Date**	30/01/2025
Assessment Reference	Be_Green_E	**Prop Type Ref**	
Property			

SAP Rating	79 C	**DER**	4.36	**TER**	11.14
Environmental	96 A	**% DER < TER**			60.86
CO_2 Emissions (t/year)	0.58	**DFEE**	38.37	**TFEE**	46.75
Compliance Check	See BREL	**% DFEE < TFEE**			17.93
% DPER < TPER	21.86	**DPER**	45.64	**TPER**	58.41

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	61.4300 (1b)	x	2.9000 (2b)	=	178.1470	(1b) - (3b)
First floor	53.9500 (1c)	x	2.8000 (2c)	=	151.0600	(1c) - (3c)
Second floor	36.1100 (1d)	x	3.5000 (2d)	=	126.3850	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 151.4900						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	455.5920	(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) =	78.3000	(23c)

Effective ac	0.2854	0.2819	0.2785	0.2611	0.2577	0.2403	0.2403	0.2368	0.2473	0.2577	0.2646	0.2715	(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	
Windows (Uw = 1.20)			30.3700	1.1450	34.7748			(27)
GF - Rooflight			2.0000	1.1450	2.2901			(27a)
Loft - Rooflight			3.8400	1.1450	4.3969			(27a)
Heatloss Floor - GF			61.4000	0.1000	6.1400			(28a)
External Wall - GF	64.7300	17.9100	46.8200	0.1400	6.5548			(29a)
External Wall - 1F	59.4300	11.3600	48.0700	0.0000	0.0000			(29a)
External Wall - Loft	59.5200	1.1000	58.4200	0.1400	8.1788			(29a)
External Roof - GF	20.0000	2.0000	18.0000	0.1000	1.8000			(30)
External Roof - 1F	17.5500		17.5500	0.1000	1.7550			(30)
External Roof - Loft	36.1100	3.8400	32.2700	0.1000	3.2270			(30)
Total net area of external elements Aum(A, m2)			270.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		69.1174			(33)
Party Wall - GF			36.1300	0.0000	0.0000			(32)

Party Wall - 1F	31.8200	0.0000	0.0000		(32)
Party Wall - Loft	30.8300	0.0000	0.0000		(32)
Party Floor - 1F	36.4000				(32d)
Party Floor - Loft	36.1100				(32d)
Party Ceiling - GF	41.4000				(32b)
Party Ceiling - 1F	36.4000				(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	13.5335	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	82.6509	(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	42.9095	42.3880	41.8665	39.2589	38.7374	36.1299	36.1299	35.6084	37.1729	38.7374	39.7804	40.8235	(38)
Heat transfer coeff	125.5604	125.0389	124.5174	121.9099	121.3884	118.7808	118.7808	118.2593	119.8238	121.3884	122.4314	123.4744	(39)
Average = Sum(39)m / 12 =												121.7795	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8288	0.8254	0.8220	0.8047	0.8013	0.7841	0.7841	0.7806	0.7910	0.8013	0.8082	0.8151	(40)
HLP (average)												0.8039	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9365	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	91.8189	90.4390	88.4283	84.5811	81.7420	78.5759	76.7763	78.7718	80.9592	84.3587	88.2885	91.4671	(42a)
Hot water usage for baths	33.3803	32.8846	32.1865	30.8993	29.9355	28.8667	28.2894	28.9827	29.7375	30.8811	32.1948	33.2675	(42b)
Hot water usage for other uses	47.0554	45.3443	43.6331	41.9220	40.2109	38.4998	38.4998	40.2109	41.9220	43.6331	45.3443	47.0554	(42c)
Average daily hot water use (litres/day)												158.3804	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	172.2546	168.6679	164.2479	157.4025	151.8884	145.9424	143.5655	147.9654	152.6187	158.8729	165.8275	171.7899	(44)
Energy conte	272.8092	240.1808	252.4430	215.4761	204.4710	179.4533	173.6301	183.2120	188.1941	215.5890	236.2517	268.9815	(45)
Energy content (annual)											Total = Sum(45)m =	2630.6918	
Distribution loss (46)m = 0.15 x (45)m	40.9214	36.0271	37.8664	32.3214	30.6707	26.9180	26.0445	27.4818	28.2291	32.3384	35.4377	40.3472	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
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	272.8092	240.1808	252.4430	215.4761	204.4710	179.4533	173.6301	183.2120	188.1941	215.5890	236.2517	268.9815	(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	272.8092	240.1808	252.4430	215.4761	204.4710	179.4533	173.6301	183.2120	188.1941	215.5890	236.2517	268.9815	(64)
										Total per year (kWh/year) = Sum(64)m =		2630.6918	(64)
12Total per year (kWh/year)												2631	(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	90.7090	79.8601	83.9373	71.6458	67.9866	59.6682	57.7320	60.9180	62.5745	71.6833	78.5537	89.4364	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.4819	179.8907	162.4819	167.8980	162.4819	167.8980	162.4819	162.4819	167.8980	162.4819	167.8980	162.4819	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	322.1386	325.4814	317.0577	299.1246	276.4872	255.2113	240.9977	237.6549	246.0787	264.0118	286.6491	307.9250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	(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)	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	(71)
Water heating gains (Table 5)	121.9208	118.8395	112.8189	99.5081	91.3799	82.8725	77.5968	81.8790	86.9091	96.3486	109.1023	120.2102	(72)
Total internal gains	676.5887	694.2589	662.4059	636.5780	600.3964	573.0292	548.1238	549.0632	567.9331	592.8896	633.6968	660.6644	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	16.9900	11.2829	0.6300	0.7000	0.7700	58.5851	(75)
Southwest	7.3800	36.7938	0.6300	0.7000	0.7700	82.9857	(79)
Northwest	6.0000	11.2829	0.6300	0.7000	0.7700	20.6893	(81)
Northeast	2.0000	26.0000	0.6300	0.7000	1.0000	20.6388	(82)
Northwest	3.8400	18.0708	0.6300	0.7000	1.0000	27.5417	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	210.4406	403.4450	668.5847	1019.0346	1311.9459	1376.5526	1296.3770	1067.1341	788.5752	477.6060	260.3227	174.7080	(83)
Total gains	887.0293	1097.7039	1330.9906	1655.6126	1912.3423	1949.5818	1844.5008	1616.1974	1356.5083	1070.4956	894.0194	835.3725	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	83.7855	84.1349	84.4873	86.2944	86.6651	88.5677	88.5677	88.9582	87.7967	86.6651	85.9268	85.2010	
alpha	6.5857	6.6090	6.6325	6.7530	6.7777	6.9045	6.9045	6.9305	6.8531	6.7777	6.7285	6.6801	
util living area	0.9980	0.9917	0.9615	0.8156	0.5834	0.3896	0.2833	0.3365	0.6013	0.9312	0.9937	0.9986	(86)
MIT	20.0894	20.3046	20.6043	20.9058	20.9900	20.9995	21.0000	20.9999	20.9916	20.7993	20.3862	20.0654	(87)
Th 2	20.2284	20.2314	20.2343	20.2492	20.2522	20.2671	20.2671	20.2701	20.2612	20.2522	20.2462	20.2403	(88)
util rest of house	0.9974	0.9891	0.9507	0.7813	0.5389	0.3451	0.2361	0.2832	0.5404	0.9072	0.9914	0.9982	(89)
MIT 2	19.1528	19.4292	19.8048	20.1620	20.2448	20.2669	20.2671	20.2701	20.2561	20.0578	19.5460	19.1314	(90)
Living area fraction										fLA = Living area / (4) =		0.1444	(91)
MIT	19.2880	19.5555	19.9202	20.2694	20.3524	20.3726	20.3729	20.3754	20.3623	20.1649	19.6673	19.2663	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2880	19.5555	19.9202	20.2694	20.3524	20.3726	20.3729	20.3754	20.3623	20.1649	19.6673	19.2663	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9862	0.9454	0.7823	0.5449	0.3515	0.2430	0.2908	0.5488	0.9039	0.9890	0.9974	(94)
Useful gains	883.7082	1082.5129	1258.2977	1295.1638	1042.0691	685.3510	448.1320	470.0692	744.5152	967.6627	884.1654	833.1784	(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	1881.9015	1832.5138	1671.0475	1386.0388	1050.3011	685.6781	448.1514	470.1333	750.3676	1161.0621	1538.6314	1860.2987	(97)
Space heating kWh	742.6558	504.0006	307.0858	65.4300	6.1246	0.0000	0.0000	0.0000	0.0000	143.8892	471.2155	764.1775	(98a)
Space heating requirement - total per year (kWh/year)												3004.5790	
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	742.6558	504.0006	307.0858	65.4300	6.1246	0.0000	0.0000	0.0000	0.0000	143.8892	471.2155	764.1775	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3004.5790	
Space heating per m2											(98c) / (4) =	19.8335	(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 %) 170.0000 (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	742.6558	504.0006	307.0858	65.4300	6.1246	0.0000	0.0000	0.0000	0.0000	143.8892	471.2155	764.1775	(98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)	436.8564	296.4710	180.6387	38.4882	3.6027	0.0000	0.0000	0.0000	0.0000	84.6407	277.1856	449.5162	(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	272.8092	240.1808	252.4430	215.4761	204.4710	179.4533	173.6301	183.2120	188.1941	215.5890	236.2517	268.9815	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month	160.4760	141.2828	148.4959	126.7507	120.2771	105.5607	102.1353	107.7718	110.7024	126.8171	138.9716	158.2244	(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	72.6985	65.6632	72.6985	70.3534	72.6985	70.3534	72.6985	72.6985	70.3534	72.6985	70.3534	72.6985	(231)
Lighting	37.2875	29.9134	26.9337	19.7328	15.2422	12.4530	13.9044	18.0735	23.4757	30.8014	34.7901	38.3238	(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												1767.3994	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.0000	
Water heating fuel used												1547.4657	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.5400)

mechanical ventilation fans (SFP = 1.5400) 855.9662 (230a)

Total electricity for the above, kWh/year 855.9662 (231)

Electricity for lighting (calculated in Appendix L) 300.9315 (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	4471.7629	(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	1767.3994	0.1578	278.8973	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1547.4657	0.1416	219.0875	(264)
Space and water heating			497.9848	(265)
Pumps, fans and electric keep-hot	855.9662	0.1387	118.7331	(267)
Energy for lighting	300.9315	0.1443	43.4337	(268)
Total CO2, kg/year			660.1516	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.3600	(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	1767.3994	1.5841	2799.7865	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1547.4657	1.5235	2357.6238	(278)
Space and water heating			5157.4104	(279)
Pumps, fans and electric keep-hot	855.9662	1.5128	1294.9057	(281)
Energy for lighting	300.9315	1.5338	461.5788	(282)
Total Primary energy kWh/year			6913.8949	(286)
Dwelling Primary energy Rate (DPER)			45.6400	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4300 (1b)	x	2.9000 (2b)	=	178.1470	(1b) - (3b)
First floor	53.9500 (1c)	x	2.8000 (2c)	=	151.0600	(1c) - (3c)
Second floor	36.1100 (1d)	x	3.5000 (2d)	=	126.3850	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	455.5920	(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) =	0.0878	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3378	(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) =	0.3125	(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	0.3984	0.3906	0.3828	0.3437	0.3359	0.2968	0.2968	0.2890	0.3125	0.3359	0.3515	0.3671	(22b)
Effective ac	0.5794	0.5763	0.5733	0.5591	0.5564	0.5441	0.5441	0.5418	0.5488	0.5564	0.5618	0.5674	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			30.3700	1.1450	34.7748			(27)

GF - Rooflight			2.0000	2.0221	4.0441	(27a)
Loft - Rooflight			3.8400	2.0221	7.7647	(27a)
Heatloss Floor - GF			61.4000	0.1300	7.9820	(28a)
External Wall - GF	64.7300	17.9100	46.8200	0.1800	8.4276	(29a)
External Wall - 1F	59.4300	11.3600	48.0700	0.1800	8.6526	(29a)
External Wall - Loft	59.5200	1.1000	58.4200	0.1800	10.5156	(29a)
External Roof - GF	20.0000	2.0000	18.0000	0.1100	1.9800	(30)
External Roof - 1F	17.5500		17.5500	0.1100	1.9305	(30)
External Roof - Loft	36.1100	3.8400	32.2700	0.1100	3.5497	(30)
Total net area of external elements Aum(A, m2)			318.7400			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		89.6216	(33)
Party Wall - GF			36.1300	0.0000	0.0000	(32)
Party Wall - 1F			31.8200	0.0000	0.0000	(32)
Party Wall - Loft			30.8300	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
E5 Ground floor (normal)	61.4300	0.1600	9.8288
E6 Intermediate floor within a dwelling	38.2400	0.0000	0.0000
E16 Corner (normal)	18.4000	0.0900	1.6560
E18 Party wall between dwellings	18.4000	0.0600	1.1040

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.5888	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	102.2104	(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	87.1037	86.6404	86.1863	84.0533	83.6542	81.7964	81.7964	81.4524	82.5120	83.6542	84.4615	85.3056	(38)
Heat transfer coeff	189.3141	188.8508	188.3967	186.2637	185.8646	184.0069	184.0069	183.6628	184.7225	185.8646	186.6720	187.5160	(39)
Average = Sum(39)m / 12 =												186.2618	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2497	1.2466	1.2436	1.2295	1.2269	1.2146	1.2146	1.2124	1.2194	1.2269	1.2322	1.2378	(40)
HLP (average)												1.2295	
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												2.9365	(42)
Hot water usage for mixer showers	73.4551	72.3512	70.7426	67.6649	65.3936	62.8607	61.4210	63.0174	64.7674	67.4870	70.6308	73.1737	(42a)
Hot water usage for baths	31.7113	31.2404	30.5772	29.3543	28.4387	27.4234	26.8750	27.5335	28.2506	29.3370	30.5850	31.6041	(42b)
Hot water usage for other uses	44.7026	43.0770	41.4515	39.8259	38.2004	36.5748	36.5748	38.2004	39.8259	41.4515	43.0770	44.7026	(42c)
Average daily hot water use (litres/day)												137.7633	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.8690	146.6686	142.7713	136.8452	132.0327	126.8589	124.8708	128.7513	132.8439	138.2754	144.2928	149.4804	(44)
Energy conte	237.3559	208.8542	219.4342	187.3342	177.7414	155.9879	151.0204	159.4210	163.8098	187.6385	205.5716	234.0502	(45)
Energy content (annual)										Total = Sum(45)m =		2288.2192	
Distribution loss (46)m = 0.15 x (45)m	35.6034	31.3281	32.9151	28.1001	26.6612	23.3982	22.6531	23.9132	24.5715	28.1458	30.8357	35.1075	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
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	283.9508	250.9399	266.0291	232.4261	224.3363	201.0797	197.6153	206.0159	208.9016	234.2334	250.6634	280.6451	(62)
WWHRS	-33.5806	-29.6990	-31.0990	-25.7512	-23.9992	-20.5363	-19.2495	-20.4699	-21.2477	-25.0486	-28.3771	-32.9587	(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	250.3702	221.2409	234.9300	206.6748	200.3371	180.5434	178.3658	185.5460	187.6540	209.1847	222.2864	247.6863	(64)
									Total per year (kWh/year) = Sum(64)m =			2524.8196	(64)
12Total per year (kWh/year)												2525	(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	116.1968	103.1126	110.2378	98.3621	96.3749	87.9394	87.4902	90.2834	90.5402	99.6657	104.4260	115.0976	(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	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.4819	179.8907	162.4819	167.8980	162.4819	167.8980	162.4819	162.4819	167.8980	162.4819	167.8980	162.4819	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	322.1386	325.4814	317.0577	299.1246	276.4872	255.2113	240.9977	237.6549	246.0787	264.0118	286.6491	307.9250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	(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)	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	(71)
Water heating gains (Table 5)	156.1784	153.4414	148.1691	136.6140	129.5362	122.1381	117.5944	121.3487	125.7503	133.9593	145.0362	154.7011	(72)
Total internal gains	710.8463	728.8608	697.7560	673.6839	638.5527	612.2948	588.1214	588.5329	606.7743	630.5003	669.6306	695.1554	(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	16.9900	11.2829	0.6300	0.7000	0.7700	58.5851	(75)
Southwest	7.3800	36.7938	0.6300	0.7000	0.7700	82.9857	(79)
Northwest	6.0000	11.2829	0.6300	0.7000	0.7700	20.6893	(81)
Northeast	2.0000	26.0000	0.6300	0.7000	1.0000	20.6388	(82)
Northwest	3.8400	18.0708	0.6300	0.7000	1.0000	27.5417	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	210.4406	403.4450	668.5847	1019.0346	1311.9459	1376.5526	1296.3770	1067.1341	788.5752	477.6060	260.3227	174.7080	(83)
Total gains	921.2870	1132.3058	1366.3407	1692.7185	1950.4986	1988.8474	1884.4984	1655.6670	1395.3495	1108.1063	929.9533	869.8634	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5697	55.7061	55.8404	56.4798	56.6011	57.1725	57.1725	57.2796	56.9511	56.6011	56.3563	56.1026	
alpha	4.7046	4.7137	4.7227	4.7653	4.7734	4.8115	4.8115	4.8186	4.7967	4.7734	4.7571	4.7402	
util living area	0.9979	0.9940	0.9807	0.9213	0.7734	0.5718	0.4254	0.5003	0.7880	0.9688	0.9951	0.9984	(86)
MIT	19.4416	19.6684	20.0316	20.5157	20.8464	20.9717	20.9944	20.9885	20.8777	20.4002	19.8362	19.4108	(87)
Th 2	19.8805	19.8829	19.8853	19.8964	19.8985	19.9083	19.9083	19.9101	19.9045	19.8985	19.8943	19.8899	(88)
util rest of house	0.9971	0.9920	0.9739	0.8951	0.7120	0.4828	0.3221	0.3868	0.7042	0.9534	0.9931	0.9978	(89)
MIT 2	18.0692	18.3603	18.8219	19.4193	19.7776	19.8935	19.9067	19.9063	19.8241	19.2970	18.5839	18.0362	(90)
Living area fraction										fLA = Living area / (4) =		0.1444	(91)
MIT	18.2673	18.5492	18.9965	19.5775	19.9319	20.0491	20.0637	20.0626	19.9762	19.4562	18.7647	18.2346	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2673	18.5492	18.9965	19.5775	19.9319	20.0491	20.0637	20.0626	19.9762	19.4562	18.7647	18.2346	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9883	0.9664	0.8859	0.7140	0.4947	0.3370	0.4031	0.7104	0.9450	0.9899	0.9965	(94)
Useful gains	917.0684	1119.0428	1320.4008	1499.5712	1392.7205	983.9047	635.0543	667.4432	991.2172	1047.1347	920.5753	866.7950	(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	2644.2156	2577.6548	2354.3001	1988.8384	1530.0169	1002.6793	637.3481	672.6767	1085.4731	1646.0637	2177.4663	2631.7175	(97)
Space heating kWh	1284.9975	980.1873	769.2211	352.2723	102.1486	0.0000	0.0000	0.0000	0.0000	445.6032	904.9616	1313.1024	(98a)
Space heating requirement - total per year (kWh/year)												6152.4938	
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	1284.9975	980.1873	769.2211	352.2723	102.1486	0.0000	0.0000	0.0000	0.0000	445.6032	904.9616	1313.1024	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6152.4938	
Space heating per m2											(98c) / (4) =	40.6132	(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	1284.9975	980.1873	769.2211	352.2723	102.1486	0.0000	0.0000	0.0000	0.0000	445.6032	904.9616	1313.1024	(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)	1392.1966	1061.9580	833.3923	381.6602	110.6702	0.0000	0.0000	0.0000	0.0000	482.7770	980.4567	1422.6461	(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	250.3702	221.2409	234.9300	206.6748	200.3371	180.5434	178.3658	185.5460	187.6540	209.1847	222.2864	247.6863	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.1964	86.9933	86.5171	85.2451	82.6280	79.8000	79.8000	79.8000	79.8000	85.7118	86.8681	87.2386	(217)
Fuel for water heating, kWh/month	287.1338	254.3196	271.5416	242.4477	242.4565	226.2448	223.5160	232.5138	235.1554	244.0560	255.8896	283.9182	(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	33.7605	27.0840	24.3861	17.8663	13.8004	11.2751	12.5892	16.3640	21.2552	27.8879	31.4993	34.6988	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-56.2839	-78.7518	-112.3256	-125.2307	-134.0554	-124.6555	-122.9785	-116.4912	-105.0264	-89.4045	-61.6096	-48.7197	(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	-33.6617	-70.5873	-139.9299	-209.6875	-276.8710	-278.1614	-275.0196	-233.1549	-171.1988	-100.9472	-44.9319	-26.6476	(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	6665.7571	(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	2999.1931	(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)	272.4669	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3036.3317	(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	6987.0854	(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	6665.7571	0.2100	1399.8090	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2999.1931	0.2100	629.8305	(264)
Space and water heating			2029.6395	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	272.4669	0.1443	39.3254	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1175.5329	0.1348	-158.4366	
PV Unit electricity exported	-1860.7987	0.1260	-234.3715	
Total			-392.8081	(269)
Total CO2, kg/year			1688.0861	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1400	(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	6665.7571	1.1300	7532.3056	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2999.1931	1.1300	3389.0882	(278)
Space and water heating			10921.3938	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	272.4669	1.5338	417.9188	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1175.5329	1.4981	-1761.1006	
PV Unit electricity exported	-1860.7987	0.4623	-860.3076	
Total			-2621.4083	(283)
Total Primary energy kWh/year			8848.0051	(286)
Target Primary Energy Rate (TPER)			58.4100	(287)

Full SAP Calculation Printout

Property Reference	Be_Green_Manor_Lodge_West	**Issued on Date**	30/01/2025
Assessment Reference	Be_Green_W	**Prop Type Ref**	
Property			

SAP Rating	78 C	**DER**	4.43	**TER**	10.56
Environmental	96 A	**% DER < TER**			58.05
CO_2 Emissions (t/year)	0.59	**DFEE**	39.01	**TFEE**	44.24
Compliance Check	See BREL	**% DFEE < TFEE**			11.82
% DPER < TPER	16.11	**DPER**	46.38	**TPER**	55.28

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	61.4300 (1b)	x	2.9000 (2b)	=	178.1470	(1b) - (3b)
First floor	53.9500 (1c)	x	2.8000 (2c)	=	151.0600	(1c) - (3c)
Second floor	36.1100 (1d)	x	3.5000 (2d)	=	126.3850	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	455.5920	(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) =	78.3000	(23c)

Effective ac	0.2854	0.2819	0.2785	0.2611	0.2577	0.2403	0.2403	0.2368	0.2473	0.2577	0.2646	0.2715	(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	
Windows (Uw = 1.20)			30.3700	1.1450	34.7748			(27)
GF - Rooflight			2.0000	1.1450	2.2901			(27a)
Loft - Rooflight			3.8400	1.1450	4.3969			(27a)
Heatloss Floor - GF			61.4000	0.1000	6.1400			(28a)
External Wall - GF	64.7300	17.9100	46.8200	0.1400	6.5548			(29a)
External Wall - 1F	59.4300	11.3600	48.0700	0.1400	6.7298			(29a)
External Wall - Loft	59.5200	1.1000	58.4200	0.1400	8.1788			(29a)
External Roof - GF	20.0000	2.0000	18.0000	0.1000	1.8000			(30)
External Roof - 1F	17.5500		17.5500	0.1000	1.7550			(30)
External Roof - Loft	36.1100	3.8400	32.2700	0.1000	3.2270			(30)
Total net area of external elements Aum(A, m2)			318.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.8472			(33)
Party Wall - GF			36.1300	0.0000	0.0000			(32)

Party Wall - 1F	31.8200	0.0000	0.0000	(32)
Party Wall - Loft	30.8300	0.0000	0.0000	(32)
Party Ceiling - GF	41.4000			(32b)
Party Ceiling - 1F	36.4000			(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		15.9370 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	91.7842 (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	42.9095	42.3880	41.8665	39.2589	38.7374	36.1299	36.1299	35.6084	37.1729	38.7374	39.7804	40.8235	(38)
Heat transfer coeff	134.6937	134.1722	133.6507	131.0432	130.5217	127.9141	127.9141	127.3926	128.9571	130.5217	131.5647	132.6077	(39)
Average = Sum(39)m / 12 =												130.9128	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8891	0.8857	0.8822	0.8650	0.8616	0.8444	0.8444	0.8409	0.8513	0.8616	0.8685	0.8754	(40)
HLP (average)												0.8642	
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												2.9365	(42)
Hot water usage for mixer showers	91.8189	90.4390	88.4283	84.5811	81.7420	78.5759	76.7763	78.7718	80.9592	84.3587	88.2885	91.4671	(42a)
Hot water usage for baths	33.3803	32.8846	32.1865	30.8993	29.9355	28.8667	28.2894	28.9827	29.7375	30.8811	32.1948	33.2675	(42b)
Hot water usage for other uses	47.0554	45.3443	43.6331	41.9220	40.2109	38.4998	38.4998	40.2109	41.9220	43.6331	45.3443	47.0554	(42c)
Average daily hot water use (litres/day)												158.3804	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	172.2546	168.6679	164.2479	157.4025	151.8884	145.9424	143.5655	147.9654	152.6187	158.8729	165.8275	171.7899	(44)
Energy conte	272.8092	240.1808	252.4430	215.4761	204.4710	179.4533	173.6301	183.2120	188.1941	215.5890	236.2517	268.9815	(45)
Energy content (annual)										Total = Sum(45)m =		2630.6918	
Distribution loss (46)m = 0.15 x (45)m	40.9214	36.0271	37.8664	32.3214	30.6707	26.9180	26.0445	27.4818	28.2291	32.3384	35.4377	40.3472	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
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	272.8092	240.1808	252.4430	215.4761	204.4710	179.4533	173.6301	183.2120	188.1941	215.5890	236.2517	268.9815	(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	272.8092	240.1808	252.4430	215.4761	204.4710	179.4533	173.6301	183.2120	188.1941	215.5890	236.2517	268.9815	(64)
									Total per year (kWh/year) = Sum(64)m =			2630.6918	(64)
12Total per year (kWh/year)												2631	(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	90.7090	79.8601	83.9373	71.6458	67.9866	59.6682	57.7320	60.9180	62.5745	71.6833	78.5537	89.4364	(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	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.4819	179.8907	162.4819	167.8980	162.4819	167.8980	162.4819	162.4819	167.8980	162.4819	167.8980	162.4819	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	322.1386	325.4814	317.0577	299.1246	276.4872	255.2113	240.9977	237.6549	246.0787	264.0118	286.6491	307.9250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	(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)	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	(71)
Water heating gains (Table 5)	121.9208	118.8395	112.8189	99.5081	91.3799	82.8725	77.5968	81.8790	86.9091	96.3486	109.1023	120.2102	(72)
Total internal gains	676.5887	694.2589	662.4059	636.5780	600.3964	573.0292	548.1238	549.0632	567.9331	592.8896	633.6968	660.6644	(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	16.9900	11.2829	0.6300	0.7000	0.7700	58.5851	(75)
Southeast	6.0000	36.7938	0.6300	0.7000	0.7700	67.4680	(77)
Southwest	7.3800	36.7938	0.6300	0.7000	0.7700	82.9857	(79)
Northeast	2.0000	26.0000	0.6300	0.7000	1.0000	20.6388	(82)
Southeast	3.8400	37.0308	0.6300	0.7000	1.0000	56.4385	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	286.1162	525.5143	812.2116	1149.2223	1407.9654	1448.3169	1375.4923	1176.4371	928.8674	606.7173	349.8470	240.1249	(83)
Total gains	962.7048	1219.7733	1474.6174	1785.8003	2008.3617	2021.3461	1923.6161	1725.5003	1496.8005	1199.6069	983.5438	900.7894	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	78.1041	78.4077	78.7137	80.2800	80.6007	82.2438	82.2438	82.5805	81.5786	80.6007	79.9617	79.3328	
alpha	6.2069	6.2272	6.2476	6.3520	6.3734	6.4829	6.4829	6.5054	6.4386	6.3734	6.3308	6.2889	
util living area	0.9970	0.9874	0.9497	0.8076	0.5945	0.4043	0.2925	0.3394	0.5858	0.9116	0.9908	0.9980	(86)
MIT	20.0420	20.2895	20.6001	20.8930	20.9852	20.9990	20.9999	20.9997	20.9903	20.8029	20.3628	20.0102	(87)
Th 2	20.1768	20.1797	20.1826	20.1973	20.2003	20.2150	20.2150	20.2180	20.2091	20.2003	20.1944	20.1885	(88)
util rest of house	0.9961	0.9836	0.9361	0.7714	0.5467	0.3550	0.2404	0.2818	0.5223	0.8825	0.9875	0.9974	(89)
MIT 2	19.0523	19.3686	19.7547	20.0989	20.1893	20.2145	20.2150	20.2179	20.2033	20.0139	19.4751	19.0207	(90)
Living area fraction										fLA = Living area / (4) =		0.1444	(91)
MIT	19.1952	19.5015	19.8767	20.2135	20.3042	20.3277	20.3283	20.3308	20.3169	20.1278	19.6032	19.1635	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1952	19.5015	19.8767	20.2135	20.3042	20.3277	20.3283	20.3308	20.3169	20.1278	19.6032	19.1635	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9945	0.9796	0.9301	0.7722	0.5530	0.3621	0.2479	0.2901	0.5311	0.8794	0.9841	0.9962	(94)
Useful gains	957.4274	1194.8844	1371.5372	1378.9995	1110.6821	732.0103	476.8621	500.6387	794.9688	1054.9670	967.9428	897.3516	(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	2006.2863	1959.1189	1787.8108	1482.5574	1123.0336	732.6595	476.9046	500.7523	801.7191	1243.5887	1644.9849	1984.2799	(97)
Space heating kWh	780.3510	513.5656	309.7076	74.5617	9.1895	0.0000	0.0000	0.0000	0.0000	140.3346	487.4703	808.6746	(98a)
Space heating requirement - total per year (kWh/year)												3123.8549	
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	780.3510	513.5656	309.7076	74.5617	9.1895	0.0000	0.0000	0.0000	0.0000	140.3346	487.4703	808.6746	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3123.8549	
Space heating per m2											(98c) / (4) =	20.6209	(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 %) 170.0000 (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	780.3510	513.5656	309.7076	74.5617	9.1895	0.0000	0.0000	0.0000	0.0000	140.3346	487.4703	808.6746	(98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)	459.0300	302.0974	182.1809	43.8598	5.4056	0.0000	0.0000	0.0000	0.0000	82.5497	286.7473	475.6910	(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	272.8092	240.1808	252.4430	215.4761	204.4710	179.4533	173.6301	183.2120	188.1941	215.5890	236.2517	268.9815	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month	160.4760	141.2828	148.4959	126.7507	120.2771	105.5607	102.1353	107.7718	110.7024	126.8171	138.9716	158.2244	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	72.6985	65.6632	72.6985	70.3534	72.6985	70.3534	72.6985	72.6985	70.3534	72.6985	70.3534	72.6985	(231)
Lighting	37.2875	29.9134	26.9337	19.7328	15.2422	12.4530	13.9044	18.0735	23.4757	30.8014	34.7901	38.3238	(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 1837.5617 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 170.0000
Water heating fuel used 1547.4657 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.5400)
mechanical ventilation fans (SFP = 1.5400) 855.9662 (230a)
Total electricity for the above, kWh/year 855.9662 (231)
Electricity for lighting (calculated in Appendix L) 300.9315 (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	4541.9252	(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	1837.5617	0.1579	290.0799	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1547.4657	0.1416	219.0875	(264)
Space and water heating			509.1674	(265)
Pumps, fans and electric keep-hot	855.9662	0.1387	118.7331	(267)
Energy for lighting	300.9315	0.1443	43.4337	(268)
Total CO2, kg/year			671.3341	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.4300	(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	1837.5617	1.5843	2911.3259	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1547.4657	1.5235	2357.6238	(278)
Space and water heating			5268.9497	(279)
Pumps, fans and electric keep-hot	855.9662	1.5128	1294.9057	(281)
Energy for lighting	300.9315	1.5338	461.5788	(282)
Total Primary energy kWh/year			7025.4342	(286)
Dwelling Primary energy Rate (DPER)			46.3800	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4300 (1b)	x	2.9000 (2b)	=	178.1470	(1b) - (3b)
First floor	53.9500 (1c)	x	2.8000 (2c)	=	151.0600	(1c) - (3c)
Second floor	36.1100 (1d)	x	3.5000 (2d)	=	126.3850	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	151.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	455.5920	(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) =	0.0878	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3378	(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) =	0.3125	(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	0.3984	0.3906	0.3828	0.3437	0.3359	0.2968	0.2968	0.2890	0.3125	0.3359	0.3515	0.3671	(22b)
Effective ac	0.5794	0.5763	0.5733	0.5591	0.5564	0.5441	0.5441	0.5418	0.5488	0.5564	0.5618	0.5674	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			30.3700	1.1450	34.7748			(27)
GF - Rooflight			2.0000	2.0221	4.0441			(27a)
Loft - Rooflight			3.8400	2.0221	7.7647			(27a)

Heatloss Floor - GF			61.4000	0.1300	7.9820	(28a)
External Wall - GF	64.7300	17.9100	46.8200	0.1800	8.4276	(29a)
External Wall - 1F	59.4300	11.3600	48.0700	0.1800	8.6526	(29a)
External Wall - Loft	59.5200	1.1000	58.4200	0.1800	10.5156	(29a)
External Roof - GF	20.0000	2.0000	18.0000	0.1100	1.9800	(30)
External Roof - 1F	17.5500		17.5500	0.1100	1.9305	(30)
External Roof - Loft	36.1100	3.8400	32.2700	0.1100	3.5497	(30)
Total net area of external elements Aum(A, m2)			318.7400			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		89.6216	(33)
Party Wall - GF			36.1300	0.0000	0.0000	(32)
Party Wall - 1F			31.8200	0.0000	0.0000	(32)
Party Wall - Loft			30.8300	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
E5 Ground floor (normal)	61.4300	0.1600	9.8288
E6 Intermediate floor within a dwelling	38.2400	0.0000	0.0000
E16 Corner (normal)	18.4000	0.0900	1.6560
E18 Party wall between dwellings	18.4000	0.0600	1.1040

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.5888 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 102.2104 (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	87.1037	86.6404	86.1863	84.0533	83.6542	81.7964	81.7964	81.4524	82.5120	83.6542	84.4615	85.3056	(38)
Heat transfer coeff	189.3141	188.8508	188.3967	186.2637	185.8646	184.0069	184.0069	183.6628	184.7225	185.8646	186.6720	187.5160	(39)

Average = Sum(39)m / 12 = 186.2618

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2497	1.2466	1.2436	1.2295	1.2269	1.2146	1.2146	1.2124	1.2194	1.2269	1.2322	1.2378	(40)
HLP (average)												1.2295	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9365 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	73.4551	72.3512	70.7426	67.6649	65.3936	62.8607	61.4210	63.0174	64.7674	67.4870	70.6308	73.1737	(42a)
Hot water usage for baths	31.7113	31.2404	30.5772	29.3543	28.4387	27.4234	26.8750	27.5335	28.2506	29.3370	30.5850	31.6041	(42b)
Hot water usage for other uses	44.7026	43.0770	41.4515	39.8259	38.2004	36.5748	36.5748	38.2004	39.8259	41.4515	43.0770	44.7026	(42c)

Average daily hot water use (litres/day) 137.7633 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.8690	146.6686	142.7713	136.8452	132.0327	126.8589	124.8708	128.7513	132.8439	138.2754	144.2928	149.4804	(44)
Energy conte	237.3559	208.8542	219.4342	187.3342	177.7414	155.9879	151.0204	159.4210	163.8098	187.6385	205.5716	234.0502	(45)

Energy content (annual) Total = Sum(45)m = 2288.2192

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

	35.6034	31.3281	32.9151	28.1001	26.6612	23.3982	22.6531	23.9132	24.5715	28.1458	30.8357	35.1075	(46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss

	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
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

	283.9508	250.9399	266.0291	232.4261	224.3363	201.0797	197.6153	206.0159	208.9016	234.2334	250.6634	280.6451	(62)
WWHRS	-33.5806	-29.6990	-31.0990	-25.7512	-23.9992	-20.5363	-19.2495	-20.4699	-21.2477	-25.0486	-28.3771	-32.9587	(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	250.3702	221.2409	234.9300	206.6748	200.3371	180.5434	178.3658	185.5460	187.6540	209.1847	222.2864	247.6863	(64)

Total per year (kWh/year) = Sum(64)m = 2524.8196 (64)

12Total per year (kWh/year) 2525 (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

	116.1968	103.1126	110.2378	98.3621	96.3749	87.9394	87.4902	90.2834	90.5402	99.6657	104.4260	115.0976	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	146.8245	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.4819	179.8907	162.4819	167.8980	162.4819	167.8980	162.4819	162.4819	167.8980	162.4819	167.8980	162.4819	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	322.1386	325.4814	317.0577	299.1246	276.4872	255.2113	240.9977	237.6549	246.0787	264.0118	286.6491	307.9250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	37.6824	(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)	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	-117.4596	(71)
Water heating gains (Table 5)	156.1784	153.4414	148.1691	136.6140	129.5362	122.1381	117.5944	121.3487	125.7503	133.9593	145.0362	154.7011	(72)
Total internal gains	710.8463	728.8608	697.7560	673.6839	638.5527	612.2948	588.1214	588.5329	606.7743	630.5003	669.6306	695.1554	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	16.9900	11.2829	0.6300	0.7000	0.7700	58.5851	(75)
Southeast	6.0000	36.7938	0.6300	0.7000	0.7700	67.4680	(77)
Southwest	7.3800	36.7938	0.6300	0.7000	0.7700	82.9857	(79)
Northeast	2.0000	26.0000	0.6300	0.7000	1.0000	20.6388	(82)
Southeast	3.8400	37.0308	0.6300	0.7000	1.0000	56.4385	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	286.1162	525.5143	812.2116	1149.2223	1407.9654	1448.3169	1375.4923	1176.4371	928.8674	606.7173	349.8470	240.1249	(83)
Total gains	996.9625	1254.3752	1509.9676	1822.9062	2046.5181	2060.6117	1963.6137	1764.9700	1535.6417	1237.2176	1019.4776	935.2803	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5697	55.7061	55.8404	56.4798	56.6011	57.1725	57.1725	57.2796	56.9511	56.6011	56.3563	56.1026	
alpha	4.7046	4.7137	4.7227	4.7653	4.7734	4.8115	4.8115	4.8186	4.7967	4.7734	4.7571	4.7402	
util living area	0.9970	0.9909	0.9719	0.9014	0.7505	0.5542	0.4089	0.4714	0.7426	0.9537	0.9928	0.9978	(86)
MIT	19.4935	19.7500	20.1204	20.5741	20.8656	20.9751	20.9953	20.9910	20.9062	20.4745	19.8967	19.4559	(87)
Th 2	19.8805	19.8829	19.8853	19.8964	19.8985	19.9083	19.9083	19.9101	19.9045	19.8985	19.8943	19.8899	(88)
util rest of house	0.9960	0.9879	0.9624	0.8710	0.6877	0.4671	0.3093	0.3634	0.6553	0.9326	0.9899	0.9970	(89)
MIT 2	18.1355	18.4638	18.9313	19.4842	19.7943	19.8954	19.9070	19.9072	19.8454	19.3841	18.6605	18.0939	(90)
Living area fraction										fLA = Living area / (4) =		0.1444	(91)
MIT	18.3315	18.6495	19.1029	19.6416	19.9489	20.0513	20.0641	20.0637	19.9985	19.5415	18.8390	18.2905	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3315	18.6495	19.1029	19.6416	19.9489	20.0513	20.0641	20.0637	19.9985	19.5415	18.8390	18.2905	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9938	0.9830	0.9536	0.8627	0.6908	0.4788	0.3236	0.3790	0.6635	0.9236	0.9858	0.9953	(94)
Useful gains	990.7449	1233.0317	1439.8848	1572.5488	1413.7464	986.7116	635.4919	668.8764	1018.8896	1142.7272	1004.9916	930.8708	(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	2656.3692	2596.5977	2374.3533	2000.7674	1533.1830	1003.0771	637.4129	672.8853	1089.5877	1661.9170	2191.3397	2642.1906	(97)
Space heating kWh	1239.2245	916.3164	695.2445	308.3174	88.8608	0.0000	0.0000	0.0000	0.0000	386.2772	854.1706	1273.2219	(98a)
Space heating requirement - total per year (kWh/year)												5761.6334	
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	1239.2245	916.3164	695.2445	308.3174	88.8608	0.0000	0.0000	0.0000	0.0000	386.2772	854.1706	1273.2219	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5761.6334	
Space heating per m2											(98c) / (4) =	38.0331	(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	1239.2245	916.3164	695.2445	308.3174	88.8608	0.0000	0.0000	0.0000	0.0000	386.2772	854.1706	1273.2219	(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)	1342.6050	992.7588	753.2444	334.0384	96.2739	0.0000	0.0000	0.0000	0.0000	418.5019	925.4286	1379.4387	(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	250.3702	221.2409	234.9300	206.6748	200.3371	180.5434	178.3658	185.5460	187.6540	209.1847	222.2864	247.6863	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.1480	86.8940	86.3406	84.9548	82.3650	79.8000	79.8000	79.8000	79.8000	85.4158	86.7790	87.1984	(217)
Fuel for water heating, kWh/month	287.2931	254.6101	272.0968	243.2761	243.2308	226.2448	223.5160	232.5138	235.1554	244.9016	256.1523	284.0491	(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	33.7605	27.0840	24.3861	17.8663	13.8004	11.2751	12.5892	16.3640	21.2552	27.8879	31.4993	34.6988	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-56.2839	-78.7518	-112.3256	-125.2307	-134.0554	-124.6555	-122.9785	-116.4912	-105.0264	-89.4045	-61.6096	-48.7197	(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	-33.6617	-70.5873	-139.9299	-209.6875	-276.8710	-278.1614	-275.0196	-233.1549	-171.1988	-100.9472	-44.9319	-26.6476	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	6242.2898	(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	3003.0400	(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)	272.4669	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3036.3317	(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	6567.4650	(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	6242.2898	0.2100	1310.8808	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3003.0400	0.2100	630.6384	(264)
Space and water heating			1941.5193	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	272.4669	0.1443	39.3254	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1175.5329	0.1348	-158.4366	
PV Unit electricity exported	-1860.7987	0.1260	-234.3715	
Total			-392.8081	(269)
Total CO2, kg/year			1599.9658	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.5600	(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	6242.2898	1.1300	7053.7874	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3003.0400	1.1300	3393.4352	(278)
Space and water heating			10447.2226	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	272.4669	1.5338	417.9188	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1175.5329	1.4981	-1761.1006	
PV Unit electricity exported	-1860.7987	0.4623	-860.3076	
Total			-2621.4083	(283)
Total Primary energy kWh/year			8373.8340	(286)
Target Primary Energy Rate (TPER)			55.2800	(287)

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