LOVE DESIGN STUDIO

December 2023

Land Northeast of Thaxted Road

Energy and Sustainability Statement

Contents

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Section Zero

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Executive Summary

Love Design Studio are appointed to prepare an energy and sustainability statement for the Land Northeast of Thaxted Road, Saffron Walden.

This assessment is to support an outline planning application for development of the site for up to 55 dwellings, associated landscaping, and open space, with access from Knight Park.

The energy strategy follows the energy hierarchy; avoiding unnecessary energy use, use energy more efficiently, use renewable energy, and offset emissions, as per the Energy Efficiency and Renewable Energy Supplementary Planning Document (2007).

The proposed energy strategy capitalises on passive design measures to maximise the fabric energy efficiency. The scheme will benefit from Mechanical Ventilation with Heat Recovery (MVHR) to minimise heating and cooling demand. The scheme will then make use of Air Source Heat Pumps (ASHPs) for space heating and domestic hot water. Heat-pump solutions for space heating and hot water will remove the need for on-site combustion.

The proposed energy strategy has been set out within this report and the scheme is currently demonstrating a combined on-site regulated **CO_2 reduction of 59%** (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.

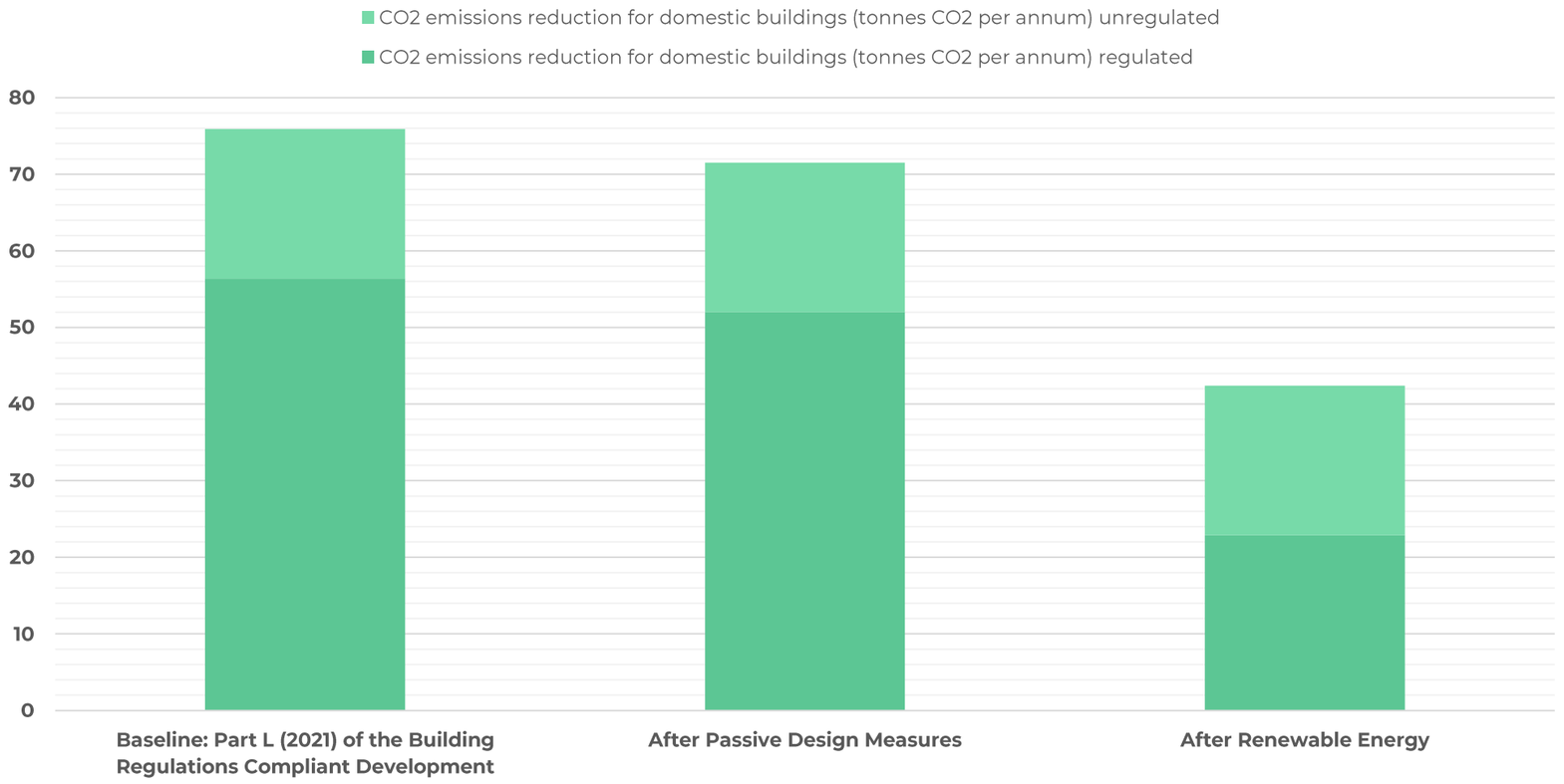

Figure 1: Total site-wide CO2 savings of the proposed development

Table 1: Total site-wide CO2 savings of the proposed development

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	4	8%
Savings from renewable energy	29	51%
Cumulative savings	**33**	**59%**

Section One

1 Introduction

Site Overview

Love Design Studio are appointed to prepare an energy and sustainability statement for the Land Northeast of Thaxted Road, Saffron Walden.

This assessment is to support an outline planning application for development of the site for up to 55 dwellings, associated landscaping, and open space, with access from Knight Park.

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

Figure 2: Site boundary (red)

National Planning Policy

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

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

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

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

New development should be planned for in ways that:

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

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

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

- Section 14, paragraphs 153-155 of the National Planning Policy Framework

"Achieving sustainable development means that the planning system has 3 overarching objectives, which are interdependent and need to be pursued in mutually supportive ways:

- *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, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.*- Section 14, paragraphs 153-155 of the National Planning Policy Framework"

- Section 2, paragraphs 7-14 of the National Planning Policy Framework

Local Planning Policy

Uttlesford District Council

The Local Planning Authority, Uttlesford District Council, have a statutory guide to development within the borough and use policies and guides to do so. The current development framework within Uttlesford is comprised of the Local Plan (2005) and various Supplementary Planning Documents (SPD); those of which relevant to energy and sustainability will be discussed below. The Local Plan documents include a variety of overarching spatial policies to guide future development and land use in the District and have full weight in the determination of planning applications.

Furthermore, Uttlesford District Council declared a climate and ecological emergency in 2019 and has committed to become net-zero carbon by 2030. 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 proposal, found in the Local Plan (2005), Energy Efficiency and Renewable Energy SPD (2007) and Interim Climate Change Planning Policy (2021) are expanded on in the following sections.

Local Plan (2005)

The 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 Uttlesford. The Local Plan document does not stipulate any CO2 reduction targets; therefore. other documents that form part of the Local Plan will be relied upon to achieve compliance in this report.

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

- Policy GEN2 – Design
- Policy GEN3 – Flood Protection
- Policy ENV10 - Noise Sensitive Development and Disturbance from Aircraft
- Policy ENV11 - Noise Generators
- Policy ENV12 –Protection of Water Resources
- Policy ENV13 – Exposure to Poor Air Quality
- Policy ENV14 – Contaminated Land
- Policy ENV15 - Renewable Energy

Energy Efficiency and Renewable Energy - Supplementary Planning Document (2007)

This SPD is intended to support the Local Plan. It sets targets and guidance for new residential and commercial development to achieve regarding energy efficiency and low carbon / renewable energy.

A key target that this scheme will adhere to is following the energy hierarchy:

1) Avoiding Unnecessary Energy Use - maximise passive design
2) Use Energy more Efficiently - good building fabric and energy efficient appliances
3) Use Renewable Energy - incorporate low-carbon and/or renewable energy sources
4) Offsetting Emissions - developers should seek to offset the emissions from their development via an offsetting contribution that would be put towards decarbonising the existing building stock

Local Planning Policy

Sustainable Standards for New Development

Following the adoption of the Essex Urban Place Supplement and the Energy Efficiency and Renewable Energy SPD, both in 2007, Uttlesford published a 'Sustainability Standards for New Development' in 2009 that sets out key energy and sustainability policies that new developments must adhere to.

The requirements relevant to the proposed scheme are listed below:

- Code for Sustainable Homes level 3 (or equivalent)
- 100% of a development's annual energy needs are met by on-site renewable or low-carbon technologies for development sites (or combination of adjacent development sites) over 50ha

It is worth noting that although the Code for Sustainable Homes (CfSH) was scrapped in 2016, this scheme will still employ key principles of the CfSH with an objective of demonstrating its proposed sustainability credentials.

Interim Climate Change Planning Policy

Following the declaration of a climate and ecological emergency in 2019, Uttlesford District Council published their 'Interim Climate Change Planning Policy' to bridge the gap between the existing Local Plan (2005) and a new local plan which is undergoing consultation.

Although this policy document is non-binding, considerations regarding the energy and sustainability criteria contained in Interim Policies 1-12 of the document have been made.

In particular with the following recommendations under Interim Policy 12 have been acknowledged:

- Code for Sustainable Homes Level 4 (or equivalent)
- At least 19% reduction on the dwelling emission rate (DER) against Target Emission Rate (TER) as defined in the 2013 Building Regulations
- Mitigate indoor air quality issues and overheating risks

Section Two

2 Energy

Methodology and Assumptions

The scheme looks to meet operational energy targets, in reference to the Energy Efficiency and Renewable Energy Supplementary Planning Document (2007):

1. Avoiding Unnecessary Energy Use - maximise passive design
2. Use Energy more Efficiently - good building fabric and energy efficient appliances
3. Use Renewable Energy - incorporate low-carbon and/or renewable energy sources
4. Offsetting Emissions - developers should seek to offset the emissions from their development via an offsetting contribution that would be put towards decarbonising the existing building stock

On the 15th June 2022, Part L (2013) Building Regulations were replaced by Part L (2021). To achieve compliance with Part L 2021, the following assumptions, definitions, and methodology have been applied:

- SAP compliant software has been used to calculate the domestic carbon dioxide emissions for the scheme using SAP 10.2 carbon factors
- Completed checklists at this stage represent anticipated targets, post-construction testing will be required to confirm airtightness, ventilation and thermal bridging.
- Drawings used to model the scheme are based on information received from KIER on 22nd November 2023
- A full copy of the SAP calculations is contained in the appendices.

Passive Design

Passive Design Measures Summary

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

In summary, the scheme benefits from:

- Being airtight, reducing draughts and heat loss.
- A well-insulated building fabric shell.
- Mechanical Ventilation with Heat Recovery Approved Installer
- 100% efficient lighting.

The **Dwelling Fabric Energy Efficiency (DFEE) provides an 8% improvement upon building regulations** Part L (2021) standards (see Table 3).

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

Overall, the scheme meets a combined **on-site reduction of 20% against the TPER** (Part L 2021 Baseline).

These improvements against Building Regulation targets demonstrate that the proposed scheme has maximised opportunities to increase energy efficiency and reduce energy demand.

See appendix A for the full proposed passive design 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	-
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	<0.1	-	Thermal Bridging calculations to be carried out Post-Planning.
Ventilation Method	Nuaire MRXB0XAB-EC03		Mechanical Ventilation with Heat Recovery, Approved Installer
Air permeability	3.0 @50Pa (m³/(h.m²))		A low air permeability required to improve MVHR efficiency

Table 3: Area-weighted Fabric Energy Efficiency ratings for the scheme

	TFEE (kWh/m²/yr)	**DFEE (kWh/m²/yr)**	**Improvement (%)**
Development total	41	38	8%

Table 4: Dwelling Primary Energy Rate improvements for the scheme.

	TPER (kgCO2/m²/yr)	**DPER (kgCO2/m²/yr)**	**Improvement (%)**
Development total	85	68	20%

Heating Infrastructure

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.

As stated in the Energy Efficiency and Renewable Energy Supplementary Planning Document, heat networks are most suitable for large mixed use developments that have constant energy demand throughout the day. However, this current scheme is residential only.

In consideration of the above, individual efficient space heating and domestic hot water systems are advised. Therefore, there are no CO_2 savings at this stage of the energy hierarchy.

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.

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 proposed 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 scheme. A summary of the chosen technology is set out in the following sections.

Photovoltaic solar panels are also a preferred on-site renewable generation technology as electricity is off-set on-site and can be utilised by the tenants themselves. However, this is to be further reviewed at the point of a full planning application submission, including details of the potential amount of carbon that could be offset on-site from the installation of Solar Panels.

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

Table 5: Area-weighted Fabric Energy Efficiency ratings for the scheme

Technical Information		
Domestic Renewable Energy Stage		
Space Heating System	Individual ASHPs	175.1% default efficiency, MCS certified
Heating Emitter	Underfloor	-
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
	Photovoltaic Solar Panels	To be considered at a later design stage

Renewable Energy

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. Individual ASHPs have been proposed for this site. As such, a fully insulated hot water cylinder should be supplied.

As this is an outline application details regarding the location of the condensers have been omitted, however, in accordance with standard practice it is likely that the condensers will be located on flat roofs where available, or externally to the rear of each dwelling. In any event, the condensers will be situated as far away from any sensitive noise receptors as the site allows.

Further detail will be mapped out at the detailed design stage.

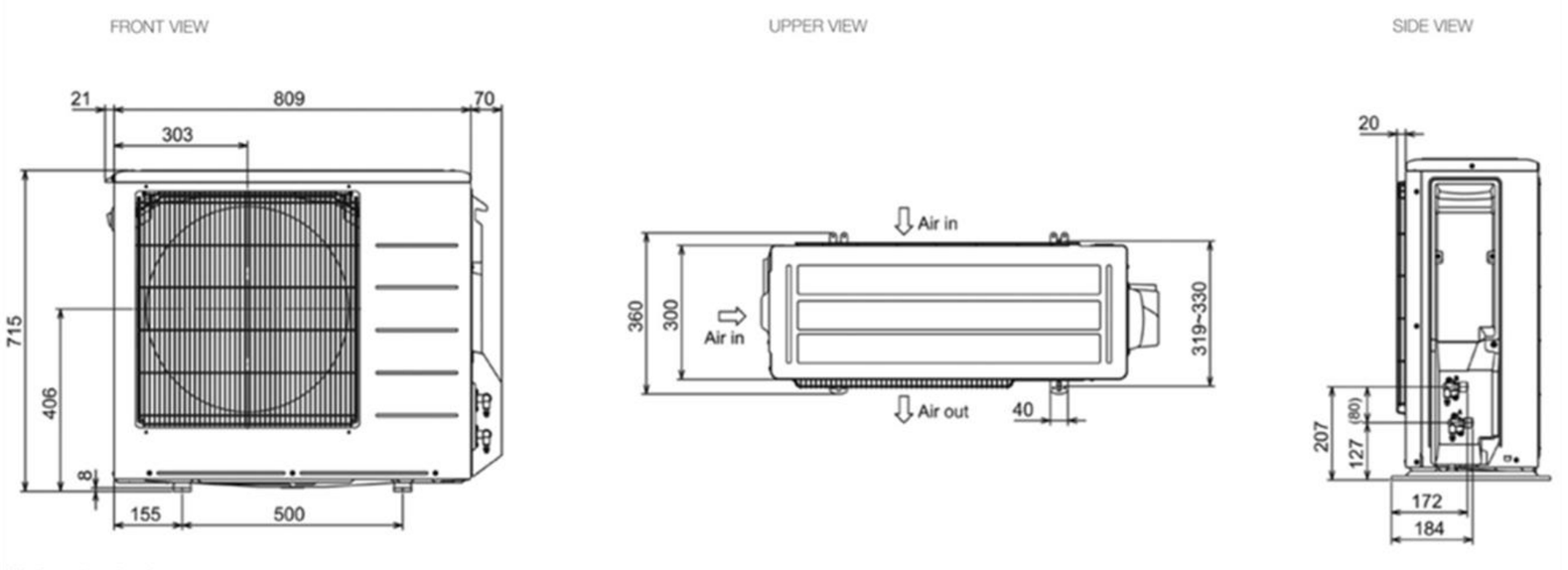

Figure 3: ©Mitsubishi QUHZ-W40VA example dimensions

Carbon Emission Results Summary

The overall energy strategy capitalises on passive design measures to maximise the fabric energy efficiency and energy demand.

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

Overall. the scheme meets a combined on-site regulated **CO_2 reduction of 59%** (Part L 2021 Baseline).

Figure 4: Total site-wide CO2 savings of the proposed development

Table 5: Regulated and unregulated CO2 emissions of the proposed development

	Carbon dioxide emissions from domestic buildings (tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2021 of the Building Regulations Compliant Development	56	20
After energy demand reduction	52	20
After renewable energy	23	20

Table 6: Total site-wide CO2 savings of the proposed development

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	4	8%
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Cumulative savings	**33**	**59%**

Section Three

3 Sustainability

Sustainability and Climate Change Appraisal

The following section sets out the sustainability credentials of the scheme in similar format to that of the, now defunct, Code for Sustainable Homes.

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

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

Energy Display Devices

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

Drying Space

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

Energy Labelled White Goods

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

External Lighting

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

The external lighting will also be designed to minimise lightspill to hedgerows or other foraging habitats.

Cycle Storage

Cycle parking should be provided for each dwelling, for example, within garden sheds or garages for the houses and cycle stores for the apartments. 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 development will look to provide direct and safe pedestrian and cycle paths from the site to the local area. Located to the south of the site are existing bus stops along Thaxted Road that provide regular bus services to nearby towns. New residents should be supplied with a guide containing information of travel routes to encourage sustainable transport.

Home Office

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

Sustainability and Climate Change Appraisal

Water and Surface Water Run-Off

Indoor Water Use

The water consumption targets for the dwellings will be 110 l/p/day, as prompted in the interim climate change policy. Consumption of potable water should be reduced in the home from all sources, including borehole well water, using water efficient fittings, appliances, and water

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

It is proposed that hard landscaping will be minimised and permeable surfaces maximised to reduce surface water run-off.

Flood Risk

Saffron Walden has been identified as a Tier 2 area of local flood risk by the Lead Local Flood Authority due to its surface water risk and flood history. To minimise flood risk as a major development, the scheme will look to incorporate appropriate SuDS measures and closely follow guidance within the Uttlesford Strategic Flood Risk Assessment (2016).

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

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

Sustainability and Climate Change Appraisal

Waste

Storage of Non-recyclable Waste and Recyclable Household Waste

The scheme should provide adequate internal and external storage space for non-recyclable waste and recyclable household waste. Space for recycling containers will:

- be located in an adequate external space
- be sized according to the frequency of collection, based on guidance from the
- recycling scheme operator
- 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 look to include procedures to sort and divert waste from landfill, through either:

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

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

Composting

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

Pollution

Global Warming Potential (GWP) of Insulants

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

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

NOx Emissions

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

Health and Wellbeing

Daylight

All habitable spaces will look to meet daylight targets set by the Building Research Establishment's publication "Site Layout Planning for Daylight and Sunlight – A Guide to Good Practice" (2022). This is to promote good daylighting, especially in living rooms, thereby improving quality of life and reducing the need for energy to light the home. of life and reduce the need for energy to light the home.

Sound Insulation

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

Private Space

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

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

Sustainability and Climate Change Appraisal

Management

Home User Guide

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

Considerate Constructors Scheme

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

Construction Site Impacts

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

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

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

Security

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

Ecology

To minimise reductions and promote an improvement in ecological value and enhance the ecological value of the site, the scheme will 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.

Ecological surveys will look to be conducted to demonstrate that the proposed development has no significant ecological constraints.

Section Four

4 Conclusion

Conclusion

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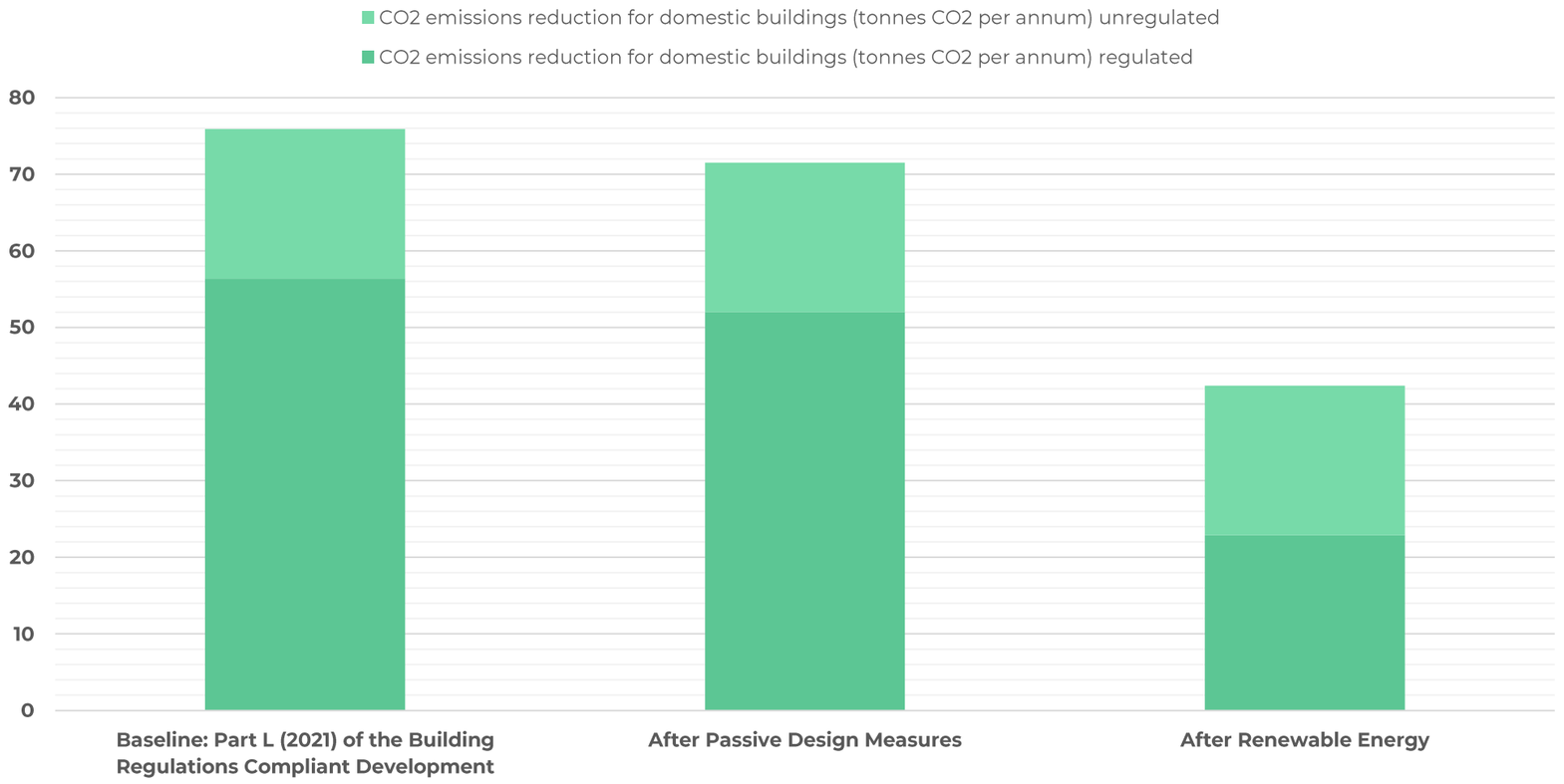

Figure 5: Total site-wide savings at each stage of the energy hierarchy

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

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Section Five

5 Appendices

Appendix A – Passive Design 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.

Building Insulation

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

Thermal Mass

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

Orientation & Site Layout

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

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

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 – Passive Design 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 will look to be 50-75% openable to allow for maximum dispersion of heat and pollution build-up such as CO_2.

Solar Shading

The scheme should utilise window reveals, balconies, and internal blinds, where feasible, to reduce the requirement for active cooling.

The scheme should adhere and comply with the requirements of the newly adopted Part O Building Regulations which governs overheating. In Particular, the scheme will adopt key principles of Table 1.2 (Limiting Solar Gains) and Table 1.4 (Removing Excess Heat) of the approved document.

Lateral hot-water pipework runs will be minimised to avoid heat loss; where there is hot water pipework and/or heat exchangers, these will be fully insulated.

Mechanical Ventilation with Heat Recovery

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.

The dwellings will have mechanical ventilation heat recovery (MVHR) systems offering fresh air supply to bedroom and living room spaces and extract from the kitchen and bathrooms; 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 by-pass mode will allow for extracting of heat build-up during hotter periods.

© Titon image of a typical MVHR unit

Appendix B - SAP Inputs

Item	Comment		
General			
Description	Outline planning application for development of the site for up to 55 dwellings, associated landscaping, and open space, with access from Knight Park.		
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	-
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	0.70	-	-
Thermal Mass Parameter	Medium	TMP	Default value
Thermal Bridging Y-value	<0.1	-	Thermal Bridging calculations TBD
Ventilation Method	Nuaire MRXB0XAB-EC03	-	Mechanical Ventilation with Heat Recovery, Approved Installer
Air permeability	3.0	@50Pa (m³/(h.m²))	-
Passive Design 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		-
Renewable Energy Stage			
Space Heating System	ASHPs		175.1% default efficiency, MCS certified
Heating Emitter	Underfloor		-
Domestic Hot Water System	Same as space heating		-
Storage	Yes		~180 litres, 100mm foam insulation
Low/Zero Carbon Technologies used	ASHPs		175.1% default efficiency, MCS certified

Appendix C - SAP DER/TER Worksheets

Full SAP Calculation Printout

Property Reference	Plot 2B	**Issued on Date**	04/12/2023
Assessment Reference	2B_MVHR	**Prop Type Ref**	2B
Property	1 Bedroom Flat, 1B, Saffron Walden, CB11		

SAP Rating	81 B	**DER**	4.88	**TER**	12.03
Environmental	96 A	**% DER < TER**			59.43
CO_2 Emissions (t/year)	0.32	**DFEE**	32.69	**TFEE**	36.67
Compliance Check	See BREL	**% DFEE < TFEE**			10.85
% DPER < TPER	17.59	**DPER**	51.83	**TPER**	62.89

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		70.0000 (1b)	x	2.5000 (2b)	=	175.0000	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.0000						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	175.0000	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If 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) =		71.1000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3071	0.3039	0.3007	0.2847	0.2816	0.2656	0.2656	0.2624	0.2720	0.2816	0.2879	0.2943	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			12.6000	1.1450	14.4275			(27)
Door			2.6000	1.0000	2.6000			(26)
Heatloss Floor 1			70.0000	0.1000	7.0000			(28a)
External Wall 1	85.0000	15.2000	69.8000	0.1400	9.7720			(29a)
Total net area of external elements Aum(A, m2)			155.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.7995			(33)
Party Ceiling 1			70.0000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	7.7500	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	41.5495	(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	17.7329	17.5488	17.3647	16.4443	16.2602	15.3398	15.3398	15.1558	15.7080	16.2602	16.6284	16.9965	(38)
Heat transfer coeff													
	59.2823	59.0983	58.9142	57.9938	57.8097	56.8893	56.8893	56.7052	57.2575	57.8097	58.1779	58.5460	(39)
Average = Sum(39)m / 12 =												57.9478	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8469	0.8443	0.8416	0.8285	0.8259	0.8127	0.8127	0.8101	0.8180	0.8259	0.8311	0.8364	(40)
HLP (average)												0.8278	
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												2.2461	(42)
Hot water usage for mixer showers													
	92.8197	91.4248	89.3921	85.5030	82.6330	79.4323	77.6131	79.6303	81.8416	85.2781	89.2508	92.4640	(42a)
Hot water usage for baths													
	26.7336	26.3365	25.7774	24.7465	23.9746	23.1187	22.6564	23.2116	23.8161	24.7319	25.7840	26.6432	(42b)
Hot water usage for other uses													
	37.6326	36.2641	34.8957	33.5272	32.1587	30.7903	30.7903	32.1587	33.5272	34.8957	36.2641	37.6326	(42c)
Average daily hot water use (litres/day)												144.5743	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	157.1858	154.0254	150.0652	143.7768	138.7663	133.3413	131.0597	135.0006	139.1849	144.9057	151.2989	156.7398	(44)
Energy conte	248.9439	219.3301	230.6446	196.8232	186.8062	163.9587	158.5054	167.1590	171.6289	196.6357	215.5531	245.4166	(45)
Energy content (annual)										Total = Sum(45)m =		2401.4052	
Distribution loss (46)m = 0.15 x (45)m													
	37.3416	32.8995	34.5967	29.5235	28.0209	24.5938	23.7758	25.0738	25.7443	29.4954	32.3330	36.8125	(46)
Water storage loss:													
Store volume												180.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8736	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.8736	(55)
Total storage loss													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	299.2883	264.8025	280.9890	245.5436	237.1506	212.6791	208.8498	217.5034	220.3493	246.9801	264.2735	295.7610	(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													
	299.2883	264.8025	280.9890	245.5436	237.1506	212.6791	208.8498	217.5034	220.3493	246.9801	264.2735	295.7610	(64)
										Total per year (kWh/year) = Sum(64)m =		2994.1703	(64)
12Total per year (kWh/year)												2994	(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													
	123.0494	109.3052	116.9649	104.4201	102.3886	93.4926	92.9786	95.8559	96.0429	105.6569	110.6477	121.8766	(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	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	101.6389	112.5288	101.6389	105.0269	101.6389	105.0269	101.6389	101.6389	105.0269	101.6389	105.0269	101.6389	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	197.2971	199.3444	194.1852	183.2019	169.3374	156.3068	147.6015	145.5542	150.7134	161.6967	175.5612	188.5918	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	(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)													
	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	(71)
Water heating gains (Table 5)													
	165.3890	162.6565	157.2109	145.0278	137.6191	129.8508	124.9712	128.8386	133.3930	142.0120	153.6774	163.8126	(72)
Total internal gains													
	524.0168	534.2216	512.7269	492.9485	468.2873	447.8764	430.9035	432.7235	445.8251	465.0395	493.9573	513.7352	(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	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825	(75)
Southeast	4.2000	36.7938	0.6300	0.7000	0.7700	47.2276	(77)
Northwest	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825	(81)

Solar gains	76.1926	139.4052	216.2954	310.8347	387.2579	401.6550	380.0815	320.4371	248.6199	160.9628	93.0133	64.0713	(83)
Total gains	600.2094	673.6268	729.0223	803.7832	855.5452	849.5314	810.9850	753.1607	694.4450	626.0022	586.9706	577.8065	(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	81.9993	82.2547	82.5117	83.8212	84.0881	85.4486	85.4486	85.7259	84.8991	84.0881	83.5560	83.0306	
alpha	6.4666	6.4836	6.5008	6.5881	6.6059	6.6966	6.6966	6.7151	6.6599	6.6059	6.5704	6.5354	
util living area													

	0.9841	0.9663	0.9248	0.8026	0.6172	0.4277	0.3086	0.3461	0.5631	0.8503	0.9634	0.9870	(86)
MIT	20.4665	20.5866	20.7331	20.8837	20.9413	20.9527	20.9535	20.9535	20.9484	20.8688	20.6562	20.4490	(87)
Th 2	20.2129	20.2151	20.2174	20.2287	20.2310	20.2423	20.2423	20.2446	20.2378	20.2310	20.2264	20.2219	(88)
util rest of house													
	0.9798	0.9577	0.9069	0.7669	0.5699	0.3775	0.2555	0.2894	0.5034	0.8125	0.9525	0.9834	(89)
MIT 2	19.5970	19.7479	19.9265	20.1047	20.1619	20.1823	20.1828	20.1852	20.1750	20.0952	19.8456	19.5829	(90)
Living area fraction										fLA = Living area / (4) =		0.2500	(91)
MIT	19.8144	19.9576	20.1282	20.2995	20.3567	20.3749	20.3754	20.3773	20.3683	20.2886	20.0483	19.7994	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8144	19.9576	20.1282	20.2995	20.3567	20.3749	20.3754	20.3773	20.3683	20.2886	20.0483	19.7994	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9544	0.9046	0.7704	0.5778	0.3863	0.2648	0.2994	0.5137	0.8156	0.9495	0.9810	(94)
Useful gains	586.4429	642.8766	659.5018	619.2029	494.3278	328.1832	214.7609	225.4832	356.7575	510.5655	557.3273	566.8045	(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													
	919.7292	889.8758	802.8933	661.0977	500.4436	328.5311	214.7825	225.5313	358.9091	560.0980	753.3020	913.2833	(97)
Space heating kWh													
	247.9651	165.9834	106.6833	30.1642	4.5501	0.0000	0.0000	0.0000	0.0000	36.8521	141.1018	257.7803	(98a)
Space heating requirement - total per year (kWh/year)												991.0804	
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													
	247.9651	165.9834	106.6833	30.1642	4.5501	0.0000	0.0000	0.0000	0.0000	36.8521	141.1018	257.7803	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												991.0804	
Space heating per m2											(98c) / (4) =	14.1583	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	219.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	247.9651	165.9834	106.6833	30.1642	4.5501	0.0000	0.0000	0.0000	0.0000	36.8521	141.1018	257.7803	(98)
Space heating efficiency (main heating system 1)													
	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)													
	113.0712	75.6878	48.6472	13.7548	2.0749	0.0000	0.0000	0.0000	0.0000	16.8044	64.3419	117.5469	(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													
	299.2883	264.8025	280.9890	245.5436	237.1506	212.6791	208.8498	217.5034	220.3493	246.9801	264.2735	295.7610	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month													
	157.1892	139.0769	147.5783	128.9620	124.5539	111.7012	109.6900	114.2350	115.7297	129.7165	138.7991	155.3367	(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	15.4855	13.9869	15.4855	14.9859	15.4855	14.9859	15.4855	15.4855	14.9859	15.4855	14.9859	15.4855	(231)
Lighting	19.6509	15.7647	14.1944	10.3994	8.0328	6.5629	7.3278	9.5249	12.3720	16.2327	18.3348	20.1971	(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	451.9290	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1572.5684	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540)		
mechanical ventilation fans (SFP = 0.8540)	182.3290	(230a)
Total electricity for the above, kWh/year	182.3290	(231)
Electricity for lighting (calculated in Appendix L)	158.5943	(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	2365.4208	(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	451.9290	0.1580	71.3857	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1572.5684	0.1410	221.7494	(264)
Space and water heating			293.1350	(265)
Pumps, fans and electric keep-hot	182.3290	0.1387	25.2913	(267)
Energy for lighting	158.5943	0.1443	22.8901	(268)
Total CO2, kg/year			341.3164	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.8800	(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	451.9290	1.5847	716.1834	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1572.5684	1.5214	2392.5262	(278)
Space and water heating			3108.7096	(279)
Pumps, fans and electric keep-hot	182.3290	1.5128	275.8273	(281)
Energy for lighting	158.5943	1.5338	243.2573	(282)
Total Primary energy kWh/year			3627.7942	(286)
Dwelling Primary energy Rate (DPER)			51.8300	(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	70.0000	(1b)	x 2.5000	(2b) =	175.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		175.0000	(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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1143 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3643 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3096 (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	0.3948	0.3871	0.3793	0.3406	0.3329	0.2942	0.2942	0.2864	0.3096	0.3329	0.3483	0.3638	(22b)
Effective ac	0.5779	0.5749	0.5719	0.5580	0.5554	0.5433	0.5433	0.5410	0.5479	0.5554	0.5607	0.5662	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.6000	1.0000	2.6000			(26)
TER Opening Type (Uw = 1.20)			12.6000	1.1450	14.4275			(27)
Heatloss Floor 1			70.0000	0.1300	9.1000			(28a)
External Wall 1	85.0000	15.2000	69.8000	0.1800	12.5640			(29a)
Total net area of external elements Aum(A, m2)			155.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.6915			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E5 Ground floor (normal)	34.0000	0.1600	5.4400
E16 Corner (normal)	5.0000	0.0900	0.4500
E18 Party wall between dwellings	5.0000	0.0600	0.3000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1900 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 44.8815 (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	33.3755	33.2008	33.0295	32.2249	32.0743	31.3736	31.3736	31.2438	31.6435	32.0743	32.3789	32.6973	(38)
Heat transfer coeff	78.2570	78.0823	77.9110	77.1064	76.9558	76.2550	76.2550	76.1253	76.5250	76.9558	77.2604	77.5787	(39)
Average = Sum(39)m / 12 =												77.1056	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1180	1.1155	1.1130	1.1015	1.0994	1.0894	1.0894	1.0875	1.0932	1.0994	1.1037	1.1083	(40)
HLP (average)												1.1015	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2461 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	61.8798	60.9498	59.5947	57.0020	55.0887	52.9549	51.7420	53.0869	54.5611	56.8521	59.5005	61.6427	(42a)
Hot water usage for baths	26.7336	26.3365	25.7774	24.7465	23.9746	23.1187	22.6564	23.2116	23.8161	24.7319	25.7840	26.6432	(42b)
Hot water usage for other uses	37.6326	36.2641	34.8957	33.5272	32.1587	30.7903	30.7903	32.1587	33.5272	34.8957	36.2641	37.6326	(42c)
Average daily hot water use (litres/day)												116.0487	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	126.2459	123.5505	120.2678	115.2758	111.2220	106.8639	105.1887	108.4572	111.9043	116.4797	121.5487	125.9184	(44)
Energy conte	199.9426	175.9342	184.8472	157.8067	149.7262	131.4016	127.2166	134.2926	137.9892	158.0618	173.1684	197.1578	(45)
Energy content (annual)											Total = Sum(45)m =	1927.5450	
Distribution loss (46)m = 0.15 x (45)m	29.9914	26.3901	27.7271	23.6710	22.4589	19.7102	19.0825	20.1439	20.6984	23.7093	25.9753	29.5737	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	249.1853	220.4115	234.0898	205.4609	198.9689	179.0558	176.4593	183.5353	185.6434	207.3045	220.8226	246.4005	(62)
WWHRS	-28.2888	-25.0189	-26.1983	-21.6933	-20.2173	-17.3001	-16.2161	-17.2442	-17.8994	-21.1014	-23.9053	-27.7650	(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	220.8965	195.3926	207.8915	183.7677	178.7515	161.7557	160.2432	166.2911	167.7440	186.2031	196.9172	218.6355	(64)
										Total per year (kWh/year) = Sum(64)m =		2244.4896	(64)
12Total per year (kWh/year)												2244	(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	105.8751	94.0799	100.8558	90.5941	89.1781	81.8144	81.6937	84.0464	84.0048	91.9497	95.7018	104.9491	(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	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	101.6389	112.5288	101.6389	105.0269	101.6389	105.0269	101.6389	101.6389	105.0269	101.6389	105.0269	101.6389	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.2971	199.3444	194.1852	183.2019	169.3374	156.3068	147.6015	145.5542	150.7134	161.6967	175.5612	188.5918	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	(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)	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	(71)
Water heating gains (Table 5)	142.3052	139.9999	135.5589	125.8251	119.8630	113.6311	109.8033	112.9656	116.6733	123.5883	132.9192	141.0606	(72)
Total internal gains	500.9331	511.5650	491.0749	473.7458	450.5312	431.6566	415.7356	416.8506	429.1054	446.6158	473.1991	490.9832	(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	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825	(75)
Southeast	4.2000	36.7938	0.6300	0.7000	0.7700	47.2276	(77)
Northwest	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	76.1926	139.4052	216.2954	310.8347	387.2579	401.6550	380.0815	320.4371	248.6199	160.9628	93.0133	64.0713	(83)
Total gains	577.1257	650.9702	707.3703	784.5805	837.7892	833.3116	795.8171	737.2878	677.7253	607.5786	566.2124	555.0545	(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	62.1173	62.2563	62.3932	63.0442	63.1676	63.7481	63.7481	63.8567	63.5232	63.1676	62.9186	62.6604	
alpha	5.1412	5.1504	5.1595	5.2029	5.2112	5.2499	5.2499	5.2571	5.2349	5.2112	5.1946	5.1774	
util living area													
	0.9916	0.9835	0.9646	0.9019	0.7665	0.5705	0.4190	0.4699	0.7201	0.9301	0.9827	0.9931	(86)
MIT	19.8684	20.0493	20.3103	20.6518	20.8863	20.9804	20.9968	20.9943	20.9381	20.6364	20.2007	19.8394	(87)
Th 2	19.9862	19.9882	19.9902	19.9996	20.0013	20.0095	20.0095	20.0111	20.0064	20.0013	19.9978	19.9941	(88)
util rest of house													
	0.9890	0.9784	0.9536	0.8729	0.7084	0.4887	0.3261	0.3715	0.6380	0.9026	0.9764	0.9909	(89)
MIT 2	18.6880	18.9179	19.2453	19.6606	19.9114	19.9991	20.0086	20.0091	19.9674	19.6540	19.1186	18.6569	(90)
Living area fraction										fLA = Living area / (4) =		0.2500	(91)
MIT	18.9831	19.2008	19.5116	19.9084	20.1551	20.2444	20.2556	20.2554	20.2101	19.8996	19.3891	18.9525	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9831	19.2008	19.5116	19.9084	20.1551	20.2444	20.2556	20.2554	20.2101	19.8996	19.3891	18.9525	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9731	0.9470	0.8699	0.7180	0.5086	0.3494	0.3962	0.6559	0.8992	0.9713	0.9877	(94)
Useful gains	568.6713	633.4825	669.8949	682.5022	601.5126	423.8235	278.0225	292.0966	444.5246	546.3309	549.9627	548.2303	(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													
	1149.0535	1116.6357	1013.7436	848.8205	650.6715	430.4157	278.7584	293.4945	467.5730	715.6609	949.4621	1144.4830	(97)
Space heating kWh													
	431.8043	324.6789	255.8234	119.7492	36.5742	0.0000	0.0000	0.0000	0.0000	125.9815	287.6396	443.6120	(98a)
Space heating requirement - total per year (kWh/year)												2025.8632	
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													
	431.8043	324.6789	255.8234	119.7492	36.5742	0.0000	0.0000	0.0000	0.0000	125.9815	287.6396	443.6120	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2025.8632	
Space heating per m2											(98c) / (4) =	28.9409	(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													
	431.8043	324.6789	255.8234	119.7492	36.5742	0.0000	0.0000	0.0000	0.0000	125.9815	287.6396	443.6120	(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)													
	467.8270	351.7648	277.1651	129.7391	39.6254	0.0000	0.0000	0.0000	0.0000	136.4914	311.6355	480.6197	(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													
	220.8965	195.3926	207.8915	183.7677	178.7515	161.7557	160.2432	166.2911	167.7440	186.2031	196.9172	218.6355	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.5352	85.1903	84.5262	83.1239	81.1978	79.8000	79.8000	79.8000	79.8000	83.2030	84.9084	85.6123	(217)
Fuel for water heating, kWh/month													
	258.2522	229.3602	245.9492	221.0769	220.1433	202.7013	200.8060	208.3848	210.2056	223.7937	231.9173	255.3786	(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	21.1186	16.9421	15.2545	11.1761	8.6327	7.0530	7.8751	10.2363	13.2959	17.4450	19.7041	21.7055	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-32.8736	-46.4122	-66.8180	-75.2641	-81.2912	-75.9416	-75.0150	-70.7566	-63.2542	-53.1420	-36.1687	-28.4144	(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	-18.3733	-38.6743	-76.9056	-115.5570	-152.8359	-153.5650	-151.7461	-128.4557	-94.1262	-55.3116	-24.5337	-14.5264	(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	2194.8680	(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	2707.9691	(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)	170.4389	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1729.9627	(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	3429.3133	(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	2194.8680	0.2100	460.9223	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2707.9691	0.2100	568.6735	(264)
Space and water heating			1029.5958	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	170.4389	0.1443	24.5996	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-705.3517	0.1345	-94.9025	
PV Unit electricity exported	-1024.6110	0.1259	-128.9835	
Total			-223.8860	(269)
Total CO2, kg/year			842.2386	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.0300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2194.8680	1.1300	2480.2009	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2707.9691	1.1300	3060.0050	(278)
Space and water heating			5540.2059	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	170.4389	1.5338	261.4248	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-705.3517	1.4973	-1056.0935	
PV Unit electricity exported	-1024.6110	0.4621	-473.4580	
Total			-1529.5516	(283)
Total Primary energy kWh/year			4402.1800	(286)
Target Primary Energy Rate (TPER)			62.8900	(287)

Full SAP Calculation Printout

Property Reference	Plot 3B	**Issued on Date**	04/12/2023
Assessment Reference	3B_MVHR	**Prop Type Ref**	3B
Property	1 Bedroom Flat, 1B, Saffron Walden, CB11		

SAP Rating	78 C	**DER**	5.08	**TER**	12.61
Environmental	96 A	**% DER < TER**			59.71
CO_2 Emissions (t/year)	0.43	**DFEE**	42.93	**TFEE**	44.82
Compliance Check	See BREL	**% DFEE < TFEE**			4.22
% DPER < TPER	18.89	**DPER**	53.53	**TPER**	66.00

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	45.0000 (1b)	x	2.5000 (2b)	=	112.5000	(1b) - (3b)
First floor	45.0000 (1c)	x	2.7500 (2c)	=	123.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	236.2500	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If 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) =	71.1000 (23c)

Effective ac	0.3071	0.3039	0.3007	0.2847	0.2816	0.2656	0.2656	0.2624	0.2720	0.2816	0.2879	0.2943	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			25.2000	1.1450	28.8550			(27)
Door			5.2000	1.0000	5.2000			(26)
Heatloss Floor 1			45.0000	0.1000	4.5000			(28a)
External Wall 1	147.0000	30.4000	116.6000	0.1400	16.3240			(29a)
External Roof 1	45.0000		45.0000	0.1000	4.5000			(30)
Total net area of external elements Aum(A, m2)			237.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		59.3790			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	11.8500	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	71.2290	(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	23.9394	23.6909	23.4423	22.1998	21.9513	20.7088	20.7088	20.4603	21.2058	21.9513	22.4483	22.9453	(38)
Heat transfer coeff													
	95.1683	94.9198	94.6713	93.4288	93.1803	91.9378	91.9378	91.6892	92.4348	93.1803	93.6773	94.1743	(39)
Average = Sum(39)m / 12 =												93.3667	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0574	1.0547	1.0519	1.0381	1.0353	1.0215	1.0215	1.0188	1.0271	1.0353	1.0409	1.0464	(40)
HLP (average)												1.0374	
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												2.6257	(42)
Hot water usage for mixer showers													
	102.3667	100.8283	98.5866	94.2975	91.1322	87.6024	85.5960	87.8207	90.2595	94.0495	98.4307	101.9745	(42a)
Hot water usage for baths													
	29.4706	29.0329	28.4165	27.2801	26.4292	25.4856	24.9760	25.5880	26.2544	27.2640	28.4238	29.3709	(42b)
Hot water usage for other uses													
	41.5200	40.0102	38.5004	36.9905	35.4807	33.9709	33.9709	35.4807	36.9905	38.5004	40.0102	41.5200	(42c)
Average daily hot water use (litres/day)												159.4480	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	173.3573	169.8714	165.5035	158.5682	153.0421	147.0589	144.5429	148.8895	153.5044	159.8139	166.8648	172.8654	(44)
Energy conte	274.5555	241.8946	254.3727	217.0719	206.0241	180.8261	174.8121	184.3563	189.2863	216.8659	237.7294	270.6655	(45)
Energy content (annual)										Total = Sum(45)m =		2648.4604	
Distribution loss (46)m = 0.15 x (45)m													
	41.1833	36.2842	38.1559	32.5608	30.9036	27.1239	26.2218	27.6534	28.3929	32.5299	35.6594	40.5998	(46)
Water storage loss:													
Store volume												180.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8736	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.8736	(55)
Total storage loss													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	324.9000	287.3670	304.7172	265.7923	256.3686	229.5465	225.1565	234.7007	238.0067	267.2103	286.4499	321.0099	(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													
	324.9000	287.3670	304.7172	265.7923	256.3686	229.5465	225.1565	234.7007	238.0067	267.2103	286.4499	321.0099	(64)
										Total per year (kWh/year) = Sum(64)m =		3241.2256	(64)
12Total per year (kWh/year)												3241	(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													
	131.5653	116.8079	124.8545	111.1527	108.7786	99.1010	98.4006	101.5740	101.9140	112.3835	118.0214	130.2718	(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	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	120.5873	133.5073	120.5873	124.6068	120.5873	124.6068	120.5873	120.5873	124.6068	120.5873	124.6068	120.5873	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	239.0777	241.5586	235.3069	221.9977	205.1972	189.4071	178.8584	176.3775	182.6292	195.9384	212.7389	228.5290	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	(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)													
	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	(71)
Water heating gains (Table 5)													
	176.8350	173.8212	167.8152	154.3788	146.2078	137.6403	132.2588	136.5242	141.5473	151.0530	163.9186	175.0965	(72)
Total internal gains													
	601.8858	614.2730	589.0951	566.3691	537.3780	514.0401	494.0903	495.8748	511.1691	532.9646	566.6501	589.5986	(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	8.4000	11.2829	0.6300	0.7000	0.7700	28.9650	(75)
Southwest	8.4000	36.7938	0.6300	0.7000	0.7700	94.4553	(79)
Northwest	8.4000	11.2829	0.6300	0.7000	0.7700	28.9650	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	152.3852	278.8104	432.5908	621.6695	774.5159	803.3100	760.1629	640.8743	497.2397	321.9256	186.0265	128.1426	(83)
Total gains	754.2711	893.0834	1021.6859	1188.0386	1311.8939	1317.3501	1254.2532	1136.7491	1008.4089	854.8901	752.6767	717.7412	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.6731	65.8450	66.0179	66.8959	67.0743	67.9808	67.9808	68.1650	67.6153	67.0743	66.7184	66.3663	
alpha	5.3782	5.3897	5.4012	5.4597	5.4716	5.5321	5.5321	5.5443	5.5077	5.4716	5.4479	5.4244	

util living area													
	0.9904	0.9763	0.9389	0.8235	0.6357	0.4438	0.3221	0.3701	0.6128	0.8932	0.9781	0.9924	(86)
MIT	20.1770	20.3458	20.5665	20.8044	20.9135	20.9405	20.9435	20.9431	20.9256	20.7559	20.4273	20.1509	(87)
Th 2	20.0358	20.0380	20.0403	20.0517	20.0540	20.0654	20.0654	20.0677	20.0609	20.0540	20.0494	20.0449	(88)
util rest of house													
	0.9874	0.9694	0.9222	0.7848	0.5790	0.3803	0.2539	0.2956	0.5373	0.8579	0.9705	0.9901	(89)
MIT 2	19.0841	19.2979	19.5702	19.8507	19.9592	19.9917	19.9933	19.9956	19.9779	19.8085	19.4119	19.0584	(90)
Living area fraction											fLA = Living area / (4) =	0.2500	(91)
MIT	19.3573	19.5599	19.8193	20.0891	20.1978	20.2289	20.2309	20.2325	20.2148	20.0454	19.6658	19.3315	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3573	19.5599	19.8193	20.0891	20.1978	20.2289	20.2309	20.2325	20.2148	20.0454	19.6658	19.3315	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9847	0.9651	0.9177	0.7865	0.5879	0.3915	0.2660	0.3088	0.5501	0.8575	0.9666	0.9878	(94)
Useful gains	742.7551	861.9447	937.5989	934.3626	771.2241	515.7170	333.6526	351.0349	554.7355	733.0722	727.5259	709.0031	(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	1432.9814	1391.5138	1260.9515	1045.3877	791.8259	517.5092	333.8144	351.3968	565.2211	880.1221	1177.1268	1425.0019	(97)
Space heating kWh	513.5284	355.8705	240.5744	79.9381	15.3278	0.0000	0.0000	0.0000	0.0000	109.4051	323.7126	532.7031	(98a)
Space heating requirement - total per year (kWh/year)												2171.0599	
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	513.5284	355.8705	240.5744	79.9381	15.3278	0.0000	0.0000	0.0000	0.0000	109.4051	323.7126	532.7031	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2171.0599	
Space heating per m2											(98c) / (4) =	24.1229	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												219.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	513.5284	355.8705	240.5744	79.9381	15.3278	0.0000	0.0000	0.0000	0.0000	109.4051	323.7126	532.7031	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	234.1671	162.2756	109.7010	36.4515	6.9894	0.0000	0.0000	0.0000	0.0000	49.8883	147.6118	242.9107	(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	324.9000	287.3670	304.7172	265.7923	256.3686	229.5465	225.1565	234.7007	238.0067	267.2103	286.4499	321.0099	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	170.6407	150.9280	160.0405	139.5968	134.6474	120.5601	118.2545	123.2672	125.0035	140.3416	150.4464	168.5976	(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	20.9054	18.8823	20.9054	20.2310	20.9054	20.2310	20.9054	20.9054	20.2310	20.9054	20.2310	20.9054	(231)
Lighting	23.3144	18.7037	16.8406	12.3382	9.5303	7.7864	8.6939	11.3007	14.6784	19.2589	21.7529	23.9624	(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												989.9954	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	
Water heating fuel used												1702.3244	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540)													
mechanical ventilation fans (SFP = 0.8540)												246.1441	(230a)
Total electricity for the above, kWh/year												246.1441	(231)
Electricity for lighting (calculated in Appendix L)												188.1608	(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												3126.6247	(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	989.9954	0.1573	155.7214	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1702.3244	0.1411	240.1200	(264)
Space and water heating			395.8414	(265)
Pumps, fans and electric keep-hot	246.1441	0.1387	34.1432	(267)
Energy for lighting	188.1608	0.1443	27.1574	(268)
Total CO2, kg/year			457.1420	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.0800	(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	989.9954	1.5823	1566.4559	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1702.3244	1.5216	2590.2145	(278)
Space and water heating			4156.6703	(279)
Pumps, fans and electric keep-hot	246.1441	1.5128	372.3669	(281)
Energy for lighting	188.1608	1.5338	288.6073	(282)
Total Primary energy kWh/year			4817.6445	(286)
Dwelling Primary energy Rate (DPER)			53.5300	(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	45.0000 (1b)	x	2.5000 (2b)	=	112.5000	(1b) - (3b)
First floor	45.0000 (1c)	x	2.7500 (2c)	=	123.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	236.2500	(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	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1270	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3770	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3204	(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	0.4086	0.4005	0.3925	0.3525	0.3445	0.3044	0.3044	0.2964	0.3204	0.3445	0.3605	0.3765	(22b)
Effective ac	0.5835	0.5802	0.5770	0.5621	0.5593	0.5463	0.5463	0.5439	0.5513	0.5593	0.5650	0.5709	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			5.2000	1.0000	5.2000			(26)
TER Opening Type (Uw = 1.20)			17.2800	1.1450	19.7863			(27)
Heatloss Floor 1			45.0000	0.1300	5.8500			(28a)
External Wall 1	147.0000	22.4800	124.5200	0.1800	22.4136			(29a)
External Roof 1	45.0000		45.0000	0.1100	4.9500			(30)
Total net area of external elements Aum(A, m2)			237.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.1999			(33)
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)	28.0000	0.1600	4.4800		
E6 Intermediate floor within a dwelling	28.0000	0.0000	0.0000		
E14 Flat roof	28.0000	0.0800	2.2400		
E16 Corner (normal)	21.0000	0.0900	1.8900		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				8.6100	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =	66.8099	(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	45.4879	45.2353	44.9876	43.8244	43.6067	42.5936	42.5936	42.4060	42.9838	43.6067	44.0470	44.5073	(38)
Heat transfer coeff	112.2978	112.0451	111.7975	110.6342	110.4166	109.4034	109.4034	109.2158	109.7937	110.4166	110.8569	111.3172	(39)
Average = Sum(39)m / 12 =												110.6332	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2478	1.2449	1.2422	1.2293	1.2269	1.2156	1.2156	1.2135	1.2199	1.2269	1.2317	1.2369	(40)
HLP (average)												1.2293	
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												2.6257	(42)
Hot water usage for mixer showers	68.2445	67.2189	65.7244	62.8650	60.7548	58.4016	57.0640	58.5472	60.1730	62.6997	65.6205	67.9830	(42a)
Hot water usage for baths	29.4706	29.0329	28.4165	27.2801	26.4292	25.4856	24.9760	25.5880	26.2544	27.2640	28.4238	29.3709	(42b)
Hot water usage for other uses	41.5200	40.0102	38.5004	36.9905	35.4807	33.9709	33.9709	35.4807	36.9905	38.5004	40.0102	41.5200	(42c)
Average daily hot water use (litres/day)												127.9884	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.2350	136.2620	132.6413	127.1357	122.6647	117.8581	116.0109	119.6159	123.4179	128.4640	134.0545	138.8739	(44)
Energy conte	220.5143	194.0352	203.8648	174.0424	165.1303	144.9203	140.3051	148.1094	152.1866	174.3245	190.9852	217.4430	(45)
Energy content (annual)										Total = Sum(45)m =		2125.8611	
Distribution loss (46)m = 0.15 x (45)m	33.0771	29.1053	30.5797	26.1064	24.7695	21.7380	21.0458	22.2164	22.8280	26.1487	28.6478	32.6165	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	269.7569	238.5125	253.1074	221.6966	214.3730	192.5745	189.5478	197.3521	199.8408	223.5672	238.6394	266.6857	(62)
WWHRS	-31.1985	-27.5922	-28.8930	-23.9245	-22.2968	-19.0795	-17.8840	-19.0179	-19.7404	-23.2718	-26.3641	-30.6208	(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	238.5584	210.9202	224.2145	197.7720	192.0762	173.4950	171.6637	178.3343	180.1004	200.2954	212.2753	236.0649	(64)
										Total per year (kWh/year) = Sum(64)m =		2415.7703	(64)
12Total per year (kWh/year)												2416	(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	112.7151	100.0985	107.1792	95.9924	94.3000	86.3094	86.0456	88.6405	88.7254	97.3570	101.6259	111.6939	(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	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	131.2860	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	122.0169	135.0901	122.0169	126.0841	122.0169	126.0841	122.0169	122.0169	126.0841	122.0169	126.0841	122.0169	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	239.0777	241.5586	235.3069	221.9977	205.1972	189.4071	178.8584	176.3775	182.6292	195.9384	212.7389	228.5290	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	36.1286	(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)	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	-105.0288	(71)
Water heating gains (Table 5)	151.4988	148.9561	144.0580	133.3228	126.7473	119.8741	115.6527	119.1405	123.2297	130.8562	141.1471	150.1263	(72)
Total internal gains	577.9792	590.9906	566.7676	546.7904	519.3471	497.7511	478.9137	479.9207	494.3289	514.1973	545.3560	566.0579	(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	5.7600	11.2829	0.6300	0.7000	0.7700	19.8617	(75)
Southwest	5.7600	36.7938	0.6300	0.7000	0.7700	64.7693	(79)
Northwest	5.7600	11.2829	0.6300	0.7000	0.7700	19.8617	(81)

Solar gains	104.4927	191.1843	296.6337	426.2877	531.0966	550.8412	521.2546	439.4567	340.9644	220.7490	127.5611	87.8692	(83)
Total gains	682.4720	782.1749	863.4013	973.0781	1050.4438	1048.5923	1000.1683	919.3773	835.2933	734.9463	672.9170	653.9271	(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	55.6556	55.7811	55.9047	56.4925	56.6038	57.1280	57.1280	57.2261	56.9249	56.6038	56.3790	56.1459	
alpha	4.7104	4.7187	4.7270	4.7662	4.7736	4.8085	4.8085	4.8151	4.7950	4.7736	4.7586	4.7431	
util living area	0.9945	0.9889	0.9755	0.9290	0.8173	0.6325	0.4738	0.5325	0.7847	0.9537	0.9890	0.9955	(86)
MIT	19.5997	19.7936	20.0877	20.4896	20.8022	20.9566	20.9911	20.9849	20.8799	20.4745	19.9726	19.5705	(87)
Th 2	19.8820	19.8842	19.8864	19.8967	19.8986	19.9075	19.9075	19.9092	19.9041	19.8986	19.8947	19.8906	(88)
util rest of house	0.9927	0.9853	0.9672	0.9047	0.7602	0.5389	0.3601	0.4133	0.7005	0.9326	0.9847	0.9941	(89)
MIT 2	18.2718	18.5197	18.8921	19.3900	19.7377	19.8840	19.9049	19.9042	19.8254	19.3841	18.7565	18.2407	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.6037	18.8381	19.1910	19.6649	20.0038	20.1521	20.1765	20.1744	20.0890	19.6567	19.0605	18.5732	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6037	18.8381	19.1910	19.6649	20.0038	20.1521	20.1765	20.1744	20.0890	19.6567	19.0605	18.5732	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9897	0.9805	0.9603	0.8985	0.7662	0.5609	0.3886	0.4431	0.7163	0.9267	0.9801	0.9915	(94)
Useful gains	675.4556	766.9367	829.1047	874.3165	804.9017	588.1046	388.6543	407.3957	598.3249	681.0554	659.5039	648.3450	(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	1606.2785	1561.7010	1418.8193	1190.9661	916.8819	607.4205	391.2780	412.2206	657.5572	1000.0130	1325.9085	1599.9812	(97)
Space heating kWh	692.5323	534.0817	438.7476	227.9877	83.3133	0.0000	0.0000	0.0000	0.0000	237.3045	479.8113	708.0174	(98a)
Space heating requirement - total per year (kWh/year)												3401.7957	
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	692.5323	534.0817	438.7476	227.9877	83.3133	0.0000	0.0000	0.0000	0.0000	237.3045	479.8113	708.0174	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3401.7957	
Space heating per m2										(98c) / (4) =		37.7977	(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	692.5323	534.0817	438.7476	227.9877	83.3133	0.0000	0.0000	0.0000	0.0000	237.3045	479.8113	708.0174	(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)	750.3058	578.6367	475.3495	247.0073	90.2636	0.0000	0.0000	0.0000	0.0000	257.1013	519.8389	767.0827	(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	238.5584	210.9202	224.2145	197.7720	192.0762	173.4950	171.6637	178.3343	180.1004	200.2954	212.2753	236.0649	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.3061	86.0523	85.5374	84.3794	82.3242	79.8000	79.8000	79.8000	79.8000	84.4410	85.8309	86.3645	(217)
Fuel for water heating, kWh/month	276.4098	245.1069	262.1246	234.3841	233.3168	217.4122	215.1175	223.4765	225.6897	237.2016	247.3180	273.3357	(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	25.3527	20.3389	18.3129	13.4168	10.3635	8.4671	9.4540	12.2886	15.9617	20.9426	23.6546	26.0573	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-41.5553	-58.3087	-83.4217	-93.3380	-100.2505	-93.4092	-92.2224	-87.2329	-78.4013	-66.4229	-45.5738	-35.9569	(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	-24.3335	-51.0883	-101.3659	-152.0033	-200.7701	-201.6708	-199.3276	-168.8972	-123.9450	-73.0176	-32.4722	-19.2527	(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 3685.5858 (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 2890.8935 (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) 204.6108 (232)

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

PV generation -2224.2377 (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	4642.8523	(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	3685.5858	0.2100	773.9730	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2890.8935	0.2100	607.0876	(264)
Space and water heating			1381.0606	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	204.6108	0.1443	29.5317	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-876.0937	0.1347	-118.0038	
PV Unit electricity exported	-1348.1441	0.1259	-169.7847	
Total			-287.7885	(269)
Total CO2, kg/year			1134.7331	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.6100	(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	3685.5858	1.1300	4164.7119	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2890.8935	1.1300	3266.7096	(278)
Space and water heating			7431.4216	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	204.6108	1.5338	313.8388	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-876.0937	1.4978	-1312.2210	
PV Unit electricity exported	-1348.1441	0.4623	-623.2288	
Total			-1935.4498	(283)
Total Primary energy kWh/year			5939.9114	(286)
Target Primary Energy Rate (TPER)			66.0000	(287)

Full SAP Calculation Printout

Property Reference	Plot 4B	**Issued on Date**	04/12/2023
Assessment Reference	4B_MVHR	**Prop Type Ref**	4B1
Property	1 Bedroom Flat, 4B1, Saffron Walden, CB11		

SAP Rating	79 C	**DER**	4.54	**TER**	11.15
Environmental	96 A	**% DER < TER**			59.28
CO_2 Emissions (t/year)	0.51	**DFEE**	42.66	**TFEE**	44.15
Compliance Check	See BREL	**% DFEE < TFEE**			3.38
% DPER < TPER	18.34	**DPER**	47.62	**TPER**	58.32

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	59.5000 (1b)	x	2.5000 (2b)	=	148.7500	(1b) - (3b)
First floor	59.5000 (1c)	x	2.7500 (2c)	=	163.6250	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	312.3750	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If 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) =	71.1000 (23c)

Effective ac	0.3071	0.3039	0.3007	0.2847	0.2816	0.2656	0.2656	0.2624	0.2720	0.2816	0.2879	0.2943	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			39.9000	1.1450	45.6870			(27)
Door			5.2000	1.0000	5.2000			(26)
Heatloss Floor 1			59.5000	0.1000	5.9500			(28a)
External Wall 1	172.0000	45.1000	126.9000	0.1400	17.7660			(29a)
External Roof 1	59.5000		59.5000	0.1000	5.9500			(30)
Total net area of external elements Aum(A, m2)			291.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		80.5530			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	14.5500	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	95.1030	(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	31.6532	31.3246	30.9960	29.3531	29.0245	27.3816	27.3816	27.0530	28.0388	29.0245	29.6817	30.3388	(38)
Heat transfer coeff													
	126.7562	126.4276	126.0990	124.4561	124.1275	122.4846	122.4846	122.1561	123.1418	124.1275	124.7847	125.4419	(39)
Average = Sum(39)m / 12 =												124.3740	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0652	1.0624	1.0597	1.0458	1.0431	1.0293	1.0293	1.0265	1.0348	1.0431	1.0486	1.0541	(40)
HLP (average)												1.0452	
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												2.8594	(42)
Hot water usage for mixer showers													
	108.2430	106.6163	104.2459	99.7106	96.3636	92.6312	90.5096	92.8621	95.4408	99.4484	104.0811	107.8283	(42a)
Hot water usage for baths													
	31.1552	30.6925	30.0410	28.8396	27.9400	26.9425	26.4037	27.0507	27.7552	28.8226	30.0487	31.0499	(42b)
Hot water usage for other uses													
	43.9128	42.3159	40.7191	39.1223	37.5255	35.9286	35.9286	37.5255	39.1223	40.7191	42.3159	43.9128	(42c)
Average daily hot water use (litres/day)												168.6029	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	183.3110	179.6248	175.0060	167.6725	161.8291	155.5023	152.8419	157.4382	162.3183	168.9900	176.4457	182.7910	(44)
Energy conte	290.3198	255.7833	268.9777	229.5352	217.8531	191.2082	184.8491	194.9414	200.1547	229.3179	251.3793	286.2065	(45)
Energy content (annual)										Total = Sum(45)m =		2800.5261	
Distribution loss (46)m = 0.15 x (45)m													
	43.5480	38.3675	40.3467	34.4303	32.6780	28.6812	27.7274	29.2412	30.0232	34.3977	37.7069	42.9310	(46)
Water storage loss:													
Store volume												180.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8736	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.8736	(55)
Total storage loss													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	340.6643	301.2557	319.3221	278.2556	268.1975	239.9286	235.1935	245.2858	248.8751	279.6623	300.0997	336.5509	(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													
	340.6643	301.2557	319.3221	278.2556	268.1975	239.9286	235.1935	245.2858	248.8751	279.6623	300.0997	336.5509	(64)
										Total per year (kWh/year) = Sum(64)m =		3393.2912	(64)
12Total per year (kWh/year)												3393	(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													
	136.8069	121.4259	129.7106	115.2968	112.7117	102.5531	101.7379	105.0936	105.5278	116.5237	122.5599	135.4392	(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	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	143.1978	158.5404	143.1978	147.9710	143.1978	147.9710	143.1978	143.1978	147.9710	143.1978	147.9710	143.1978	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	283.9056	286.8516	279.4277	263.6229	243.6723	224.9216	212.3949	209.4488	216.8728	232.6775	252.6281	271.3789	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	(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)													
	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	(71)
Water heating gains (Table 5)													
	183.8802	180.6933	174.3423	160.1344	151.4942	142.4348	136.7444	141.2548	146.5663	156.6179	170.2221	182.0419	(72)
Total internal gains													
	679.8741	694.9758	665.8582	640.6189	607.2548	581.2179	558.2276	559.7919	577.3006	601.3837	639.7118	665.5091	(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	
North	8.4000	10.6334	0.6300	0.7000	0.7700	27.2975	(74)
East	12.6000	19.6403	0.6300	0.7000	0.7700	75.6292	(76)
South	6.3000	46.7521	0.6300	0.7000	0.7700	90.0146	(78)
West	12.6000	19.6403	0.6300	0.7000	0.7700	75.6292	(80)

Solar gains	268.5706	495.4814	763.7270	1065.3169	1283.9524	1309.7794	1248.5080	1083.1952	869.4898	572.2078	328.9746	224.9251	(83)
Total gains	948.4447	1190.4571	1429.5852	1705.9358	1891.2072	1890.9973	1806.7356	1642.9871	1446.7904	1173.5915	968.6864	890.4342	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.1952	65.3646	65.5349	66.4000	66.5758	67.4688	67.4688	67.6503	67.1087	66.5758	66.2252	65.8782	

alpha	5.3463	5.3576	5.3690	5.4267	5.4384	5.4979	5.4979	5.5100	5.4739	5.4384	5.4150	5.3919	
util living area	0.9924	0.9758	0.9265	0.7873	0.5935	0.4126	0.2980	0.3414	0.5737	0.8820	0.9807	0.9944	(86)
MIT	20.1353	20.3421	20.5961	20.8308	20.9209	20.9411	20.9433	20.9430	20.9298	20.7667	20.4027	20.1023	(87)
Th 2	20.0294	20.0316	20.0339	20.0453	20.0476	20.0590	20.0590	20.0613	20.0544	20.0476	20.0430	20.0385	(88)
util rest of house	0.9900	0.9687	0.9073	0.7459	0.5383	0.3528	0.2344	0.2721	0.5007	0.8444	0.9739	0.9927	(89)
MIT 2	19.0262	19.2880	19.5988	19.8706	19.9584	19.9854	19.9865	19.9888	19.9739	19.8137	19.3763	18.9915	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	19.3035	19.5515	19.8481	20.1107	20.1990	20.2243	20.2257	20.2274	20.2129	20.0519	19.6329	19.2692	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3035	19.5515	19.8481	20.1107	20.1990	20.2243	20.2257	20.2274	20.2129	20.0519	19.6329	19.2692	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9877	0.9644	0.9030	0.7489	0.5473	0.3634	0.2457	0.2844	0.5132	0.8446	0.9702	0.9908	(94)
Useful gains	936.7768	1148.0929	1290.9632	1277.5621	1034.9885	687.1869	443.9437	467.2097	742.4974	991.1655	939.7958	882.2347	(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	1901.7806	1852.3570	1683.1831	1395.2348	1054.9612	688.8889	444.0931	467.5386	752.7478	1173.2470	1563.9128	1890.3114	(97)
Space heating kWh	717.9628	473.2655	291.8116	84.7244	14.8597	0.0000	0.0000	0.0000	0.0000	135.4686	449.3642	750.0091	(98a)
Space heating requirement - total per year (kWh/year)												2917.4659	
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	717.9628	473.2655	291.8116	84.7244	14.8597	0.0000	0.0000	0.0000	0.0000	135.4686	449.3642	750.0091	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2917.4659	
Space heating per m2											(98c) / (4) =	24.5165	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												219.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	717.9628	473.2655	291.8116	84.7244	14.8597	0.0000	0.0000	0.0000	0.0000	135.4686	449.3642	750.0091	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	327.3884	215.8073	133.0650	38.6340	6.7760	0.0000	0.0000	0.0000	0.0000	61.7732	204.9084	342.0014	(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	340.6643	301.2557	319.3221	278.2556	268.1975	239.9286	235.1935	245.2858	248.8751	279.6623	300.0997	336.5509	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	178.9203	158.2225	167.7112	146.1427	140.8600	126.0129	123.5260	128.8266	130.7117	146.8815	157.6154	176.7599	(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	27.6416	24.9666	27.6416	26.7499	27.6416	26.7499	27.6416	27.6416	26.7499	27.6416	26.7499	27.6416	(231)
Lighting	28.7637	23.0753	20.7768	15.2220	11.7579	9.6063	10.7259	13.9420	18.1093	23.7603	26.8372	29.5632	(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	1330.3538	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1782.1908	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540)		
mechanical ventilation fans (SFP = 0.8540)	325.4573	(230a)
Total electricity for the above, kWh/year	325.4573	(231)
Electricity for lighting (calculated in Appendix L)	232.1399	(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	3670.1418	(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	1330.3538	0.1577	209.7601	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1782.1908	0.1411	251.4274	(264)
Space and water heating			461.1875	(265)
Pumps, fans and electric keep-hot	325.4573	0.1387	45.1449	(267)
Energy for lighting	232.1399	0.1443	33.5050	(268)
Total CO2, kg/year			539.8374	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.5400	(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	1330.3538	1.5836	2106.8137	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1782.1908	1.5217	2711.8941	(278)
Space and water heating			4818.7078	(279)
Pumps, fans and electric keep-hot	325.4573	1.5128	492.3518	(281)
Energy for lighting	232.1399	1.5338	356.0640	(282)
Total Primary energy kWh/year			5667.1235	(286)
Dwelling Primary energy Rate (DPER)			47.6200	(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	59.5000	(1b) x	2.5000	(2b) =	148.7500	(1b) - (3b)
First floor	59.5000	(1c) x	2.7500	(2c) =	163.6250	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	119.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		312.3750	(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) =	0.1281 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3781 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3213 (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	0.4097	0.4017	0.3936	0.3535	0.3454	0.3053	0.3053	0.2972	0.3213	0.3454	0.3615	0.3776	(22b)
Effective ac	0.5839	0.5807	0.5775	0.5625	0.5597	0.5466	0.5466	0.5442	0.5516	0.5597	0.5653	0.5713	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			5.2000	1.0000	5.2000			(26)
TER Opening Type (Uw = 1.20)			24.5100	1.1450	28.0649			(27)
Heatloss Floor 1			59.5000	0.1300	7.7350			(28a)
External Wall 1	172.0000	29.7100	142.2900	0.1800	25.6122			(29a)
External Roof 1	59.5000		59.5000	0.1100	6.5450			(30)
Total net area of external elements Aum(A, m2)			291.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		73.1571			(33)
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)										40.0000	0.1600	6.4000		
E6 Intermediate floor within a dwelling										40.0000	0.0000	0.0000		
E14 Flat roof										40.0000	0.0800	3.2000		
E16 Corner (normal)										21.0000	0.0900	1.8900		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)													11.4900	(36)
Point Thermal bridges												(36a) =	0.0000	
Total fabric heat loss												(33) + (36) + (36a) =	84.6471	(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	60.1939	59.8580	59.5287	57.9819	57.6925	56.3453	56.3453	56.0958	56.8642	57.6925	58.2779	58.8900	(38)
Heat transfer coeff	144.8410	144.5051	144.1757	142.6289	142.3395	140.9923	140.9923	140.7429	141.5113	142.3395	142.9250	143.5371	(39)
Average = Sum(39)m / 12 =												142.6276	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2143	1.2116	1.1986	1.1961	1.1848	1.1848	1.1827	1.1892	1.1961	1.2011	1.2062	(40)
HLP (average)												1.1986	
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												2.8594	(42)
Hot water usage for mixer showers	72.1620	71.0775	69.4973	66.4737	64.2424	61.7541	60.3397	61.9080	63.6272	66.2989	69.3874	71.8855	(42a)
Hot water usage for baths	31.1552	30.6925	30.0410	28.8396	27.9400	26.9425	26.4037	27.0507	27.7552	28.8226	30.0487	31.0499	(42b)
Hot water usage for other uses	43.9128	42.3159	40.7191	39.1223	37.5255	35.9286	35.9286	37.5255	39.1223	40.7191	42.3159	43.9128	(42c)
Average daily hot water use (litres/day)												135.3375	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	147.2300	144.0860	140.2574	134.4356	129.7079	124.6252	122.6721	126.4842	130.5047	135.8406	141.7520	146.8482	(44)
Energy conte	233.1764	205.1766	215.5703	184.0356	174.6117	153.2413	148.3612	156.6139	160.9253	184.3344	201.9517	229.9288	(45)
Energy content (annual)											Total = Sum(45)m =	2247.9272	
Distribution loss (46)m = 0.15 x (45)m	34.9765	30.7765	32.3356	27.6053	26.1918	22.9862	22.2542	23.4921	24.1388	27.6502	30.2928	34.4893	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	282.4190	249.6538	264.8130	231.6898	223.8544	200.8954	197.6039	205.8565	208.5795	233.5770	249.6059	279.1715	(62)
WWHRS	-32.9895	-29.1761	-30.5516	-25.2979	-23.5767	-20.1748	-18.9106	-20.1096	-20.8736	-24.6077	-27.8775	-32.3785	(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	249.4296	220.4777	234.2614	206.3919	200.2777	180.7207	178.6932	185.7470	187.7059	208.9694	221.7284	246.7929	(64)
											Total per year (kWh/year) = Sum(64)m =	2521.1957	(64)
12Total per year (kWh/year)												2521	(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	116.9253	103.8030	111.0713	99.3152	97.4525	89.0761	88.7242	91.4682	91.6310	100.6853	105.2723	115.8455	(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	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	142.9683	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	143.8062	159.2140	143.8062	148.5997	143.8062	148.5997	143.8062	143.8062	148.5997	143.8062	148.5997	143.8062	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	283.9056	286.8516	279.4277	263.6229	243.6723	224.9216	212.3949	209.4488	216.8728	232.6775	252.6281	271.3789	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	37.2968	(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)	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	-114.3747	(71)
Water heating gains (Table 5)	157.1576	154.4688	149.2893	137.9378	130.9846	123.7168	119.2530	122.9412	127.2653	135.3297	146.2115	155.7063	(72)
Total internal gains	653.7599	669.4249	641.4137	619.0509	587.3536	563.1285	541.3446	542.0867	558.6283	580.7039	616.3299	639.7818	(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	
North	5.1600	10.6334	0.6300	0.7000	0.7700	16.7685	(74)
East	7.7400	19.6403	0.6300	0.7000	0.7700	46.4580	(76)
South	3.8700	46.7521	0.6300	0.7000	0.7700	55.2947	(78)
West	7.7400	19.6403	0.6300	0.7000	0.7700	46.4580	(80)

Solar gains	164.9791	304.3671	469.1466	654.4090	788.7136	804.5788	766.9406	665.3913	534.1152	351.4991	202.0844	138.1683	(83)
Total gains	818.7390	973.7920	1110.5603	1273.4599	1376.0672	1367.7073	1308.2852	1207.4780	1092.7435	932.2030	818.4143	777.9501	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.0549	57.1875	57.3182	57.9398	58.0576	58.6123	58.6123	58.7162	58.3974	58.0576	57.8198	57.5732	
alpha	4.8037	4.8125	4.8212	4.8627	4.8705	4.9075	4.9075	4.9144	4.8932	4.8705	4.8547	4.8382	
util living area	0.9964	0.9911	0.9772	0.9281	0.8132	0.6279	0.4677	0.5243	0.7804	0.9583	0.9920	0.9972	(86)
MIT	19.5734	19.7879	20.1045	20.5144	20.8171	20.9610	20.9924	20.9871	20.8895	20.4756	19.9515	19.5415	(87)
Th 2	19.9063	19.9086	19.9108	19.9212	19.9231	19.9322	19.9322	19.9339	19.9287	19.9231	19.9192	19.9150	(88)
util rest of house	0.9951	0.9882	0.9694	0.9038	0.7564	0.5362	0.3576	0.4088	0.6971	0.9391	0.9888	0.9962	(89)
MIT 2	18.2554	18.5301	18.9312	19.4388	19.7745	19.9109	19.9299	19.9295	19.8563	19.4054	18.7477	18.2208	(90)
Living area fraction										fLA = Living area / (4) =		0.2500	(91)
MIT	18.5849	18.8445	19.2245	19.7077	20.0351	20.1734	20.1955	20.1939	20.1146	19.6729	19.0486	18.5510	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5849	18.8445	19.2245	19.7077	20.0351	20.1734	20.1955	20.1939	20.1146	19.6729	19.0486	18.5510	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9929	0.9842	0.9629	0.8980	0.7629	0.5578	0.3852	0.4377	0.7131	0.9333	0.9852	0.9944	(94)
Useful gains	812.9536	958.3665	1069.3697	1143.6227	1049.8034	762.9121	503.9693	528.5232	779.2315	870.0209	806.2614	773.5809	(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	2069.0398	2015.0555	1834.5683	1541.4905	1186.4179	785.8115	506.9413	533.9680	851.1283	1291.4383	1707.7572	2059.8986	(97)
Space heating kWh	934.5282	710.0950	569.3078	286.4648	101.6413	0.0000	0.0000	0.0000	0.0000	313.5346	649.0770	957.0204	(98a)
Space heating requirement - total per year (kWh/year)												4521.6689	
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	934.5282	710.0950	569.3078	286.4648	101.6413	0.0000	0.0000	0.0000	0.0000	313.5346	649.0770	957.0204	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4521.6689	
Space heating per m2											(98c) / (4) =	37.9972	(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	934.5282	710.0950	569.3078	286.4648	101.6413	0.0000	0.0000	0.0000	0.0000	313.5346	649.0770	957.0204	(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)	1012.4899	769.3337	616.8015	310.3628	110.1205	0.0000	0.0000	0.0000	0.0000	339.6907	703.2253	1036.8585	(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	249.4296	220.4777	234.2614	206.3919	200.2777	180.7207	178.6932	185.7470	187.7059	208.9694	221.7284	246.7929	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7391	86.4889	85.9733	84.7952	82.6190	79.8000	79.8000	79.8000	79.8000	84.9675	86.3211	86.7932	(217)
Fuel for water heating, kWh/month	287.5632	254.9202	272.4816	243.4005	242.4113	226.4670	223.9264	232.7656	235.2204	245.9404	256.8646	284.3459	(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	29.8801	23.9709	21.5831	15.8127	12.2142	9.9791	11.1422	14.4831	18.8121	24.6825	27.8788	30.7105	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.3766	-74.1095	-104.9127	-116.0826	-123.5599	-114.6809	-113.1669	-107.5531	-97.5062	-83.7512	-58.2346	-46.2741	(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	-33.7432	-70.5377	-139.4175	-208.3132	-274.4561	-275.4804	-272.3269	-231.1079	-170.0406	-100.6201	-44.9596	-26.7253	(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 4898.8829 (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 3006.3070 (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) 241.1494 (232)

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

PV generation -2940.9366 (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	5291.4027	(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	4898.8829	0.2100	1028.7654	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3006.3070	0.2100	631.3245	(264)
Space and water heating			1660.0899	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	241.1494	0.1443	34.8053	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1093.2080	0.1349	-147.5104	
PV Unit electricity exported	-1847.7285	0.1260	-232.8918	
Total			-380.4022	(269)
Total CO2, kg/year			1326.4222	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1500	(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	4898.8829	1.1300	5535.7377	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3006.3070	1.1300	3397.1270	(278)
Space and water heating			8932.8646	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	241.1494	1.5338	369.8830	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1093.2080	1.4987	-1638.4029	
PV Unit electricity exported	-1847.7285	0.4627	-854.8842	
Total			-2493.2871	(283)
Total Primary energy kWh/year			6939.5613	(286)
Target Primary Energy Rate (TPER)			58.3200	(287)

Full SAP Calculation Printout

Property Reference	Plot 1BF	**Issued on Date**	04/12/2023
Assessment Reference	1B_Flat_MVHR	**Prop Type Ref**	1BF-AFF
Property	1 Bedroom Flat, 1BF-AFF, Saffron Walden, CB11		

SAP Rating	81 B	**DER**	5.57	**TER**	13.44
Environmental	96 A	**% DER < TER**			58.56
CO_2 Emissions (t/year)	0.27	**DFEE**	34.22	**TFEE**	35.22
Compliance Check	See BREL	**% DFEE < TFEE**			2.85
% DPER < TPER	16.01	**DPER**	59.29	**TPER**	70.59

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	50.0000	(1b)	x 2.5000	(2b) =	125.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	125.0000	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If 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) =		71.1000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3071	0.3039	0.3007	0.2847	0.2816	0.2656	0.2656	0.2624	0.2720	0.2816	0.2879	0.2943	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			14.7000	1.1450	16.8321			(27)
Door			2.6000	1.0000	2.6000			(26)
External Wall 1	50.0000	17.3000	32.7000	0.1400	4.5780			(29a)
External Roof 1	50.0000		50.0000	0.1000	5.0000			(30)
Total net area of external elements Aum(A, m2)			100.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.0101			(33)
Party Wall 1			53.0000	0.0000	0.0000			(32)
Party Floor 1			50.0000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	5.0000	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	34.0101	(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	12.6663	12.5348	12.4034	11.7459	11.6145	10.9570	10.9570	10.8255	11.2200	11.6145	11.8774	12.1404	(38)
Heat transfer coeff													
	46.6764	46.5449	46.4134	45.7560	45.6245	44.9671	44.9671	44.8356	45.2301	45.6245	45.8875	46.1505	(39)
Average = Sum(39)m / 12 =												45.7231	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9335	0.9309	0.9283	0.9151	0.9125	0.8993	0.8993	0.8967	0.9046	0.9125	0.9177	0.9230	(40)
HLP (average)												0.9145	
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												1.6901	(42)
Hot water usage for mixer showers													
	78.8354	77.6506	75.9242	72.6211	70.1834	67.4650	65.9198	67.6332	69.5113	72.4301	75.8042	78.5333	(42a)
Hot water usage for baths													
	22.7244	22.3869	21.9117	21.0354	20.3792	19.6517	19.2587	19.7306	20.2445	21.0230	21.9173	22.6476	(42b)
Hot water usage for other uses													
	31.9383	30.7769	29.6155	28.4541	27.2927	26.1314	26.1314	27.2927	28.4541	29.6155	30.7769	31.9383	(42c)
Average daily hot water use (litres/day)												122.7875	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	133.4981	130.8145	127.4515	122.1106	117.8554	113.2480	111.3099	114.6565	118.2099	123.0686	128.4984	133.1193	(44)
Energy conte	211.4284	186.2781	195.8881	167.1633	158.6560	139.2516	134.6196	141.9687	145.7646	167.0029	183.0696	208.4326	(45)
Energy content (annual)										Total = Sum(45)m =		2039.5237	
Distribution loss (46)m = 0.15 x (45)m													
	31.7143	27.9417	29.3832	25.0745	23.7984	20.8877	20.1929	21.2953	21.8647	25.0504	27.4604	31.2649	(46)
Water storage loss:													
Store volume												180.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8736	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.8736	(55)
Total storage loss													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	261.7728	231.7505	246.2326	215.8837	209.0005	187.9721	184.9641	192.3131	194.4850	217.3474	231.7900	258.7770	(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													
	261.7728	231.7505	246.2326	215.8837	209.0005	187.9721	184.9641	192.3131	194.4850	217.3474	231.7900	258.7770	(64)
										Total per year (kWh/year) = Sum(64)m =		2632.2888	(64)
12Total per year (kWh/year)												2632	(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													
	110.5755	98.3154	105.4084	94.5581	93.0287	85.2775	85.0366	87.4801	87.4431	95.8040	99.8470	109.5794	(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	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	74.2626	82.2193	74.2626	76.7380	74.2626	76.7380	74.2626	74.2626	76.7380	74.2626	76.7380	74.2626	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	147.2339	148.7618	144.9117	136.7153	126.3689	116.6447	110.1484	108.6205	112.4706	120.6670	131.0134	140.7376	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	(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)													
	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	(71)
Water heating gains (Table 5)													
	148.6230	146.3027	141.6779	131.3308	125.0386	118.4410	114.2965	117.5808	121.4487	128.7688	138.6763	147.2841	(72)
Total internal gains													
	421.4711	428.6353	412.2037	396.1356	377.0216	360.1753	347.0590	348.8155	359.0089	375.0500	397.7793	413.6358	(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	
North	4.2000	10.6334	0.6300	0.7000	0.7700	13.6488	(74)
East	4.2000	19.6403	0.6300	0.7000	0.7700	25.2097	(76)
West	6.3000	19.6403	0.6300	0.7000	0.7700	37.8146	(80)

Solar gains	76.6731	149.3725	247.3616	367.3137	458.8105	474.1674	449.5363	379.8559	289.4329	177.3418	95.4215	63.2064	(83)
Total gains	498.1442	578.0078	659.5653	763.4494	835.8321	834.3427	796.5953	728.6714	648.4418	552.3917	493.2008	476.8423	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.3893	74.5994	74.8107	75.8856	76.1043	77.2170	77.2170	77.4434	76.7680	76.1043	75.6682	75.2370	
alpha	5.9593	5.9733	5.9874	6.0590	6.0736	6.1478	6.1478	6.1629	6.1179	6.0736	6.0445	6.0158	

util living area													
	0.9738	0.9420	0.8654	0.6935	0.5035	0.3446	0.2483	0.2830	0.4784	0.7859	0.9427	0.9786	(86)
MIT	20.4551	20.6049	20.7769	20.9081	20.9431	20.9490	20.9494	20.9495	20.9461	20.8811	20.6584	20.4306	(87)
Th 2	20.1391	20.1413	20.1435	20.1547	20.1569	20.1681	20.1681	20.1703	20.1636	20.1569	20.1524	20.1480	(88)
util rest of house													
	0.9669	0.9283	0.8389	0.6530	0.4593	0.3000	0.2014	0.2320	0.4217	0.7407	0.9268	0.9728	(89)
MIT 2	19.5188	19.7032	19.9051	20.0535	20.0872	20.1030	20.1032	20.1056	20.0967	20.0333	19.7809	19.4961	(90)
Living area fraction										fLA = Living area / (4) =		0.2500	(91)
MIT	19.7528	19.9286	20.1230	20.2671	20.3012	20.3145	20.3148	20.3166	20.3090	20.2453	20.0003	19.7297	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7528	19.9286	20.1230	20.2671	20.3012	20.3145	20.3148	20.3166	20.3090	20.2453	20.0003	19.7297	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9631	0.9245	0.8382	0.6585	0.4670	0.3078	0.2097	0.2410	0.4316	0.7457	0.9235	0.9694	(94)
Useful gains	479.7689	534.3446	552.8303	502.7552	390.3051	256.8378	167.0342	175.5816	279.8813	411.9328	455.4712	462.2524	(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													
	721.2830	699.5069	632.2913	520.1139	392.4242	256.9653	167.0431	175.6023	280.8357	440.0608	591.9621	716.7043	(97)
Space heating kWh													
	179.6865	110.9891	59.1190	12.4983	1.5766	0.0000	0.0000	0.0000	0.0000	20.9273	98.2734	189.3123	(98a)
Space heating requirement - total per year (kWh/year)												672.3825	
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													
	179.6865	110.9891	59.1190	12.4983	1.5766	0.0000	0.0000	0.0000	0.0000	20.9273	98.2734	189.3123	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												672.3825	
Space heating per m2											(98c) / (4) =	13.4476	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												219.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	179.6865	110.9891	59.1190	12.4983	1.5766	0.0000	0.0000	0.0000	0.0000	20.9273	98.2734	189.3123	(98)
Space heating efficiency (main heating system 1)													
	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)													
	81.9364	50.6106	26.9581	5.6992	0.7189	0.0000	0.0000	0.0000	0.0000	9.5428	44.8123	86.3257	(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													
	261.7728	231.7505	246.2326	215.8837	209.0005	187.9721	184.9641	192.3131	194.4850	217.3474	231.7900	258.7770	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month													
	137.4857	121.7177	129.3238	113.3843	109.7692	98.7248	97.1450	101.0048	102.1455	114.1530	121.7384	135.9123	(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	11.0611	9.9906	11.0611	10.7042	11.0611	10.7042	11.0611	11.0611	10.7042	11.0611	10.7042	11.0611	(231)
Lighting	14.3580	11.5185	10.3711	7.5983	5.8692	4.7952	5.3541	6.9594	9.0396	11.8604	13.3963	14.7570	(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												306.6040	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	
Water heating fuel used												1382.5046	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540)													
mechanical ventilation fans (SFP = 0.8540)												130.2350	(230a)
Total electricity for the above, kWh/year												130.2350	(231)
Electricity for lighting (calculated in Appendix L)												115.8772	(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												1935.2208	(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	306.6040	0.1586	48.6234	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1382.5046	0.1409	194.8404	(264)
Space and water heating			243.4638	(265)
Pumps, fans and electric keep-hot	130.2350	0.1387	18.0652	(267)
Energy for lighting	115.8772	0.1443	16.7247	(268)
Total CO2, kg/year			278.2536	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.5700	(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	306.6040	1.5870	486.5802	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1382.5046	1.5211	2102.9565	(278)
Space and water heating			2589.5366	(279)
Pumps, fans and electric keep-hot	130.2350	1.5128	197.0195	(281)
Energy for lighting	115.8772	1.5338	177.7363	(282)
Total Primary energy kWh/year			2964.2924	(286)
Dwelling Primary energy Rate (DPER)			59.2900	(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		50.0000 (1b)	x	2.5000 (2b)	=	125.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	125.0000	(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	2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1600	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4100	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3485	(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	0.4443	0.4356	0.4269	0.3834	0.3746	0.3311	0.3311	0.3224	0.3485	0.3746	0.3921	0.4095	(22b)
Effective ac	0.5987	0.5949	0.5911	0.5735	0.5702	0.5548	0.5548	0.5520	0.5607	0.5702	0.5769	0.5838	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.6000	1.0000	2.6000			(26)
TER Opening Type (Uw = 1.20)			9.8700	1.1450	11.3015			(27)
External Wall 1	50.0000	12.4700	37.5300	0.1800	6.7554			(29a)
External Roof 1	50.0000		50.0000	0.1100	5.5000			(30)
Total net area of external elements Aum(A, m2)			100.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.1569			(33)
Party Wall 1			53.0000	0.0000	0.0000			(32)

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

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E7 Party floor between dwellings (in blocks of flats)	30.0000	0.0700	2.1000

E14 Flat roof	30.0000	0.0800	2.4000	
E16 Corner (normal)	5.0000	0.0900	0.4500	
E18 Party wall between dwellings	5.0000	0.0600	0.3000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2500 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 31.4069 (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	24.6971	24.5390	24.3840	23.6560	23.5198	22.8857	22.8857	22.7683	23.1300	23.5198	23.7953	24.0834	(38)
Heat transfer coeff	56.1040	55.9459	55.7909	55.0629	54.9267	54.2926	54.2926	54.1752	54.5369	54.9267	55.2023	55.4903	(39)

Average = Sum(39)m / 12 = 55.0623

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1221	1.1189	1.1158	1.1013	1.0985	1.0859	1.0859	1.0835	1.0907	1.0985	1.1040	1.1098	(40)
HLP (average)												1.1012	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.6901 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	52.5569	51.7671	50.6162	48.4141	46.7890	44.9767	43.9465	45.0888	46.3409	48.2867	50.5361	52.3556	(42a)
Hot water usage for baths	22.7244	22.3869	21.9117	21.0354	20.3792	19.6517	19.2587	19.7306	20.2445	21.0230	21.9173	22.6476	(42b)
Hot water usage for other uses	31.9383	30.7769	29.6155	28.4541	27.2927	26.1314	26.1314	27.2927	28.4541	29.6155	30.7769	31.9383	(42c)

Average daily hot water use (litres/day) 98.5597 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2197	104.9310	102.1434	97.9036	94.4609	90.7597	89.3366	92.1121	95.0395	98.9252	103.2304	106.9415	(44)
Energy conte	169.8097	149.4203	156.9906	134.0251	127.1626	111.5996	108.0448	114.0541	117.1932	134.2406	147.0706	167.4445	(45)
Energy content (annual)										Total = Sum(45)m =		1637.0557	
Distribution loss (46)m = 0.15 x (45)m	25.4715	22.4130	23.5486	20.1038	19.0744	16.7399	16.2067	17.1081	17.5790	20.1361	22.0606	25.1167	(46)

Water storage loss:
Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.5520 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8381 (55)

Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	219.0524	193.8975	206.2332	181.6793	176.4053	159.2538	157.2875	163.2967	164.8474	183.4833	194.7248	216.6872	(62)
WWHRS	-24.0268	-21.2495	-22.2513	-18.4249	-17.1714	-14.6937	-13.7730	-14.6462	-15.2026	-17.9222	-20.3037	-23.5819	(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	195.0256	172.6480	183.9820	163.2544	159.2339	144.5601	143.5145	148.6505	149.6447	165.5610	174.4211	193.1053	(64)
										Total per year (kWh/year) = Sum(64)m =		1993.6012	(64)
12Total per year (kWh/year)												1994	(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	95.8559	85.2640	91.5935	82.6867	81.6757	75.2302	75.3190	77.3171	77.0901	84.0291	87.0243	95.0694	(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	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	84.5050	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	74.8919	82.9161	74.8919	77.3883	74.8919	77.3883	74.8919	74.8919	77.3883	74.8919	77.3883	74.8919	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	147.2339	148.7618	144.9117	136.7153	126.3689	116.6447	110.1484	108.6205	112.4706	120.6670	131.0134	140.7376	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	31.4505	(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)	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	-67.6040	(71)
Water heating gains (Table 5)	128.8385	126.8810	123.1095	114.8427	109.7792	104.4864	101.2353	103.9208	107.0696	112.9424	120.8671	127.7815	(72)
Total internal gains	402.3159	409.9104	394.2647	380.2978	362.3915	346.8710	334.6271	335.7848	345.2800	359.8528	380.6204	394.7625	(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	
North	2.8200	10.6334	0.6300	0.7000	0.7700	9.1642	(74)
East	2.8200	19.6403	0.6300	0.7000	0.7700	16.9265	(76)
West	4.2300	19.6403	0.6300	0.7000	0.7700	25.3898	(80)

Solar gains	51.4805	100.2930	166.0857	246.6249	308.0585	318.3696	301.8315	255.0461	194.3335	119.0723	64.0687	42.4386	(83)
Total gains	453.7965	510.2033	560.3503	626.9228	670.4500	665.2406	636.4586	590.8309	539.6135	478.9251	444.6891	437.2011	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	61.8890	62.0639	62.2363	63.0592	63.2155	63.9538	63.9538	64.0924	63.6674	63.2155	62.9000	62.5735	
alpha	5.1259	5.1376	5.1491	5.2039	5.2144	5.2636	5.2636	5.2728	5.2445	5.2144	5.1933	5.1716	
util living area	0.9873	0.9759	0.9482	0.8632	0.7080	0.5140	0.3740	0.4192	0.6617	0.9032	0.9744	0.9893	(86)
MIT	19.9465	20.1314	20.4010	20.7294	20.9218	20.9880	20.9981	20.9967	20.9583	20.6998	20.2779	19.9208	(87)
Th 2	19.9828	19.9854	19.9879	19.9998	20.0020	20.0124	20.0124	20.0143	20.0084	20.0020	19.9975	19.9928	(88)
util rest of house	0.9835	0.9688	0.9331	0.8280	0.6481	0.4384	0.2908	0.3308	0.5804	0.8690	0.9656	0.9861	(89)
MIT 2	18.7839	19.0179	19.3523	19.7441	19.9423	20.0062	20.0119	20.0132	19.9832	19.7236	19.2135	18.7589	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	19.0746	19.2963	19.6145	19.9904	20.1872	20.2516	20.2584	20.2591	20.2270	19.9677	19.4796	19.0494	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0746	19.2963	19.6145	19.9904	20.1872	20.2516	20.2584	20.2591	20.2270	19.9677	19.4796	19.0494	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9626	0.9265	0.8276	0.6597	0.4570	0.3116	0.3529	0.5991	0.8676	0.9597	0.9819	(94)
Useful gains	444.1957	491.1319	519.1387	518.8399	442.3268	304.0052	198.3276	208.5027	323.3006	415.5137	426.7592	429.3021	(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	828.9126	805.4138	731.6679	610.6717	466.1732	306.8420	198.6254	209.0680	334.1481	514.5353	683.3816	823.9965	(97)
Space heating kWh	286.2294	211.1975	158.1217	66.1189	17.7417	0.0000	0.0000	0.0000	0.0000	73.6721	184.7681	293.6526	(98a)
Space heating requirement - total per year (kWh/year)												1291.5020	
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	286.2294	211.1975	158.1217	66.1189	17.7417	0.0000	0.0000	0.0000	0.0000	73.6721	184.7681	293.6526	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1291.5020	
Space heating per m2											(98c) / (4) =	25.8300	(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	286.2294	211.1975	158.1217	66.1189	17.7417	0.0000	0.0000	0.0000	0.0000	73.6721	184.7681	293.6526	(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)	310.1077	228.8163	171.3128	71.6348	19.2218	0.0000	0.0000	0.0000	0.0000	79.8180	200.1821	318.1502	(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	195.0256	172.6480	183.9820	163.2544	159.2339	144.5601	143.5145	148.6505	149.6447	165.5610	174.4211	193.1053	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.9189	84.5129	83.7220	82.2016	80.6191	79.8000	79.8000	79.8000	79.8000	82.3709	84.1892	84.9970	(217)
Fuel for water heating, kWh/month	229.6611	204.2861	219.7535	198.6025	197.5138	181.1531	179.8428	186.2789	187.5247	200.9946	207.1774	227.1907	(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	15.5611	12.4837	11.2402	8.2350	6.3610	5.1970	5.8027	7.5426	9.7970	12.8542	14.5188	15.9936	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-23.8353	-33.8373	-48.9966	-55.5475	-60.3378	-56.5348	-55.8870	-52.5677	-46.7396	-38.9469	-26.3061	-20.5838	(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	-12.7696	-26.9389	-53.6632	-80.7532	-106.8959	-107.3985	-106.0852	-89.7268	-65.6750	-38.5200	-17.0528	-10.0882	(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	1399.2438	(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	2419.9791	(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)	125.5867	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1235.6876	(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	2795.1219	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1399.2438	0.2100	293.8412	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2419.9791	0.2100	508.1956	(264)
Space and water heating			802.0368	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	125.5867	0.1443	18.1260	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-520.1204	0.1344	-69.9051	
PV Unit electricity exported	-715.5672	0.1259	-90.0551	
Total			-159.9602	(269)
Total CO2, kg/year			672.1319	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.4400	(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	1399.2438	1.1300	1581.1455	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2419.9791	1.1300	2734.5764	(278)
Space and water heating			4315.7218	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	125.5867	1.5338	192.6291	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-520.1204	1.4967	-778.4723	
PV Unit electricity exported	-715.5672	0.4620	-330.5634	
Total			-1109.0357	(283)
Total Primary energy kWh/year			3529.4161	(286)
Target Primary Energy Rate (TPER)			70.5900	(287)

Full SAP Calculation Printout

Property Reference	Plot 2BF	**Issued on Date**	04/12/2023
Assessment Reference	2BF_MVHR	**Prop Type Ref**	2BF-AFF
Property	1 Bedroom Flat, 2BF-AFF, Saffron Walden, CB11		

SAP Rating	82 B	**DER**	4.65	**TER**	10.97
Environmental	96 A	**% DER < TER**			57.61
CO_2 Emissions (t/year)	0.31	**DFEE**	29.28	**TFEE**	32.09
Compliance Check	See BREL	**% DFEE < TFEE**			8.74
% DPER < TPER	13.25	**DPER**	49.57	**TPER**	57.14

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	70.0000	(1b)	x 2.5000	(2b) =	175.0000	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.0000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		175.0000	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If 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) =		71.1000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3071	0.3039	0.3007	0.2847	0.2816	0.2656	0.2656	0.2624	0.2720	0.2816	0.2879	0.2943	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			14.7000	1.1450	16.8321			(27)
Door			2.6000	1.0000	2.6000			(26)
External Wall 1	60.0000	17.3000	42.7000	0.1400	5.9780			(29a)
External Roof 1	70.0000		70.0000	0.1000	7.0000			(30)
Total net area of external elements Aum(A, m2)			130.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.4101			(33)
Party Wall 1			53.0000	0.0000	0.0000			(32)
Party Floor 1			70.0000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	6.5000	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	38.9101	(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	17.7329	17.5488	17.3647	16.4443	16.2602	15.3398	15.3398	15.1558	15.7080	16.2602	16.6284	16.9965	(38)
Heat transfer coeff													
	56.6429	56.4588	56.2748	55.3544	55.1703	54.2499	54.2499	54.0658	54.6181	55.1703	55.5385	55.9066	(39)
Average = Sum(39)m / 12 =												55.3084	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8092	0.8066	0.8039	0.7908	0.7881	0.7750	0.7750	0.7724	0.7803	0.7881	0.7934	0.7987	(40)
HLP (average)												0.7901	
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												2.2461	(42)
Hot water usage for mixer showers													
	92.8197	91.4248	89.3921	85.5030	82.6330	79.4323	77.6131	79.6303	81.8416	85.2781	89.2508	92.4640	(42a)
Hot water usage for baths													
	26.7336	26.3365	25.7774	24.7465	23.9746	23.1187	22.6564	23.2116	23.8161	24.7319	25.7840	26.6432	(42b)
Hot water usage for other uses													
	37.6326	36.2641	34.8957	33.5272	32.1587	30.7903	30.7903	32.1587	33.5272	34.8957	36.2641	37.6326	(42c)
Average daily hot water use (litres/day)												144.5743	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	157.1858	154.0254	150.0652	143.7768	138.7663	133.3413	131.0597	135.0006	139.1849	144.9057	151.2989	156.7398	(44)
Energy conte	248.9439	219.3301	230.6446	196.8232	186.8062	163.9587	158.5054	167.1590	171.6289	196.6357	215.5531	245.4166	(45)
Energy content (annual)										Total = Sum(45)m =		2401.4052	
Distribution loss (46)m = 0.15 x (45)m													
	37.3416	32.8995	34.5967	29.5235	28.0209	24.5938	23.7758	25.0738	25.7443	29.4954	32.3330	36.8125	(46)
Water storage loss:													
Store volume												180.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8736	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.8736	(55)
Total storage loss													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(56)
If cylinder contains dedicated solar storage													
	27.0820	24.4612	27.0820	26.2084	27.0820	26.2084	27.0820	27.0820	26.2084	27.0820	26.2084	27.0820	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	299.2883	264.8025	280.9890	245.5436	237.1506	212.6791	208.8498	217.5034	220.3493	246.9801	264.2735	295.7610	(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													
	299.2883	264.8025	280.9890	245.5436	237.1506	212.6791	208.8498	217.5034	220.3493	246.9801	264.2735	295.7610	(64)
										Total per year (kWh/year) = Sum(64)m =		2994.1703	(64)
12Total per year (kWh/year)												2994	(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													
	123.0494	109.3052	116.9649	104.4201	102.3886	93.4926	92.9786	95.8559	96.0429	105.6569	110.6477	121.8766	(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	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	99.7867	110.4781	99.7867	103.1129	99.7867	103.1129	99.7867	99.7867	103.1129	99.7867	103.1129	99.7867	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	197.2971	199.3444	194.1852	183.2019	169.3374	156.3068	147.6015	145.5542	150.7134	161.6967	175.5612	188.5918	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	(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)													
	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	(71)
Water heating gains (Table 5)													
	165.3890	162.6565	157.2109	145.0278	137.6191	129.8508	124.9712	128.8386	133.3930	142.0120	153.6774	163.8126	(72)
Total internal gains													
	522.1645	532.1709	510.8746	491.0345	466.4350	445.9623	429.0512	430.8713	443.9111	463.1872	492.0433	511.8829	(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	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825	(75)
Southwest	6.3000	36.7938	0.6300	0.7000	0.7700	70.8414	(79)
Northwest	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825	(81)

Solar gains	99.8064	179.6283	271.3304	379.0257	463.6375	477.4822	453.1870	387.4336	308.2111	205.4178	121.2972	84.2798	(83)
Total gains	621.9710	711.7991	782.2049	870.0602	930.0725	923.4446	882.2383	818.3049	752.1222	668.6050	613.3405	596.1627	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	85.8203	86.1001	86.3817	87.8180	88.1110	89.6059	89.6059	89.9110	89.0019	88.1110	87.5269	86.9506	
alpha	6.7214	6.7400	6.7588	6.8545	6.8741	6.9737	6.9737	6.9941	6.9335	6.8741	6.8351	6.7967	

util living area													
	0.9787	0.9509	0.8888	0.7360	0.5475	0.3757	0.2705	0.3039	0.4990	0.7974	0.9489	0.9829	(86)
MIT	20.5408	20.6694	20.8059	20.9185	20.9500	20.9551	20.9554	20.9555	20.9532	20.9048	20.7212	20.5208	(87)
Th 2	20.2454	20.2477	20.2499	20.2613	20.2636	20.2751	20.2751	20.2773	20.2705	20.2636	20.2591	20.2545	(88)
util rest of house													
	0.9731	0.9393	0.8663	0.6993	0.5056	0.3333	0.2260	0.2562	0.4471	0.7564	0.9350	0.9783	(89)
MIT 2	19.7179	19.8774	20.0397	20.1709	20.2021	20.2177	20.2178	20.2203	20.2118	20.1624	19.9527	19.7009	(90)
Living area fraction										fLA = Living area / (4) =		0.2500	(91)
MIT	19.9236	20.0754	20.2313	20.3578	20.3891	20.4020	20.4022	20.4041	20.3972	20.3480	20.1448	19.9059	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9236	20.0754	20.2313	20.3578	20.3891	20.4020	20.4022	20.4041	20.3972	20.3480	20.1448	19.9059	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9703	0.9363	0.8657	0.7043	0.5128	0.3407	0.2338	0.2645	0.4562	0.7614	0.9326	0.9757	(94)
Useful gains	603.4837	666.4817	677.1870	612.7590	476.9246	314.6465	206.2641	216.4696	343.1150	509.0667	571.9807	581.6832	(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	884.9674	856.7846	772.7252	634.2396	479.3780	314.7606	206.2704	216.4841	343.9389	537.7994	724.4886	878.0608	(97)
Space heating kWh	209.4238	127.8835	71.0804	15.4660	1.8254	0.0000	0.0000	0.0000	0.0000	21.3772	109.8057	220.5050	(98a)
Space heating requirement - total per year (kWh/year)												777.3669	
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	209.4238	127.8835	71.0804	15.4660	1.8254	0.0000	0.0000	0.0000	0.0000	21.3772	109.8057	220.5050	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												777.3669	
Space heating per m2											(98c) / (4) =	11.1052	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												219.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	209.4238	127.8835	71.0804	15.4660	1.8254	0.0000	0.0000	0.0000	0.0000	21.3772	109.8057	220.5050	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	95.4965	58.3144	32.4124	7.0524	0.8324	0.0000	0.0000	0.0000	0.0000	9.7479	50.0710	100.5495	(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	299.2883	264.8025	280.9890	245.5436	237.1506	212.6791	208.8498	217.5034	220.3493	246.9801	264.2735	295.7610	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	157.1892	139.0769	147.5783	128.9620	124.5539	111.7012	109.6900	114.2350	115.7297	129.7165	138.7991	155.3367	(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	15.4855	13.9869	15.4855	14.9859	15.4855	14.9859	15.4855	15.4855	14.9859	15.4855	14.9859	15.4855	(231)
Lighting	19.2928	15.4774	13.9357	10.2099	7.8864	6.4433	7.1942	9.3514	12.1465	15.9369	18.0006	19.8290	(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												354.4765	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	
Water heating fuel used												1572.5684	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540)													
mechanical ventilation fans (SFP = 0.8540)												182.3290	(230a)
Total electricity for the above, kWh/year												182.3290	(231)
Electricity for lighting (calculated in Appendix L)												155.7041	(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												2265.0780	(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	354.4765	0.1587	56.2497	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1572.5684	0.1410	221.7494	(264)
Space and water heating			277.9991	(265)
Pumps, fans and electric keep-hot	182.3290	0.1387	25.2913	(267)
Energy for lighting	155.7041	0.1443	22.4729	(268)
Total CO2, kg/year			325.7633	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.6500	(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	354.4765	1.5874	562.6836	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1572.5684	1.5214	2392.5262	(278)
Space and water heating			2955.2098	(279)
Pumps, fans and electric keep-hot	182.3290	1.5128	275.8273	(281)
Energy for lighting	155.7041	1.5338	238.8242	(282)
Total Primary energy kWh/year			3469.8613	(286)
Dwelling Primary energy Rate (DPER)			49.5700	(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	70.0000	(1b)	x 2.5000	(2b) =	175.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		175.0000	(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	2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1143	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3643	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3096	(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	0.3948	0.3871	0.3793	0.3406	0.3329	0.2942	0.2942	0.2864	0.3096	0.3329	0.3483	0.3638	(22b)
Effective ac	0.5779	0.5749	0.5719	0.5580	0.5554	0.5433	0.5433	0.5410	0.5479	0.5554	0.5607	0.5662	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.6000	1.0000	2.6000			(26)
TER Opening Type (Uw = 1.20)			14.7000	1.1450	16.8321			(27)
External Wall 1	60.0000	17.3000	42.7000	0.1800	7.6860			(29a)
External Roof 1	70.0000		70.0000	0.1100	7.7000			(30)
Total net area of external elements Aum(A, m2)			130.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.8181			(33)
Party Wall 1			53.0000	0.0000	0.0000			(32)

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

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E7 Party floor between dwellings (in blocks of flats)	35.0000	0.0700	2.4500

E14 Flat roof	35.0000	0.0800	2.8000	
E16 Corner (normal)	5.0000	0.0900	0.4500	
E18 Party wall between dwellings	5.0000	0.0600	0.3000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.0000 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 40.8181 (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	33.3755	33.2008	33.0295	32.2249	32.0743	31.3736	31.3736	31.2438	31.6435	32.0743	32.3789	32.6973	(38)
Heat transfer coeff	74.1936	74.0188	73.8475	73.0429	72.8924	72.1916	72.1916	72.0619	72.4616	72.8924	73.1969	73.5153	(39)
Average = Sum(39)m / 12 =												73.0422	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0599	1.0574	1.0550	1.0435	1.0413	1.0313	1.0313	1.0295	1.0352	1.0413	1.0457	1.0502	(40)
HLP (average)												1.0435	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2461 (42)
Hot water usage for mixer showers

61.8798	60.9498	59.5947	57.0020	55.0887	52.9549	51.7420	53.0869	54.5611	56.8521	59.5005	61.6427	(42a)

Hot water usage for baths

26.7336	26.3365	25.7774	24.7465	23.9746	23.1187	22.6564	23.2116	23.8161	24.7319	25.7840	26.6432	(42b)

Hot water usage for other uses

37.6326	36.2641	34.8957	33.5272	32.1587	30.7903	30.7903	32.1587	33.5272	34.8957	36.2641	37.6326	(42c)

Average daily hot water use (litres/day) 116.0487 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	126.2459	123.5505	120.2678	115.2758	111.2220	106.8639	105.1887	108.4572	111.9043	116.4797	121.5487	125.9184	(44)
Energy conte	199.9426	175.9342	184.8472	157.8067	149.7262	131.4016	127.2166	134.2926	137.9892	158.0618	173.1684	197.1578	(45)
Energy content (annual)										Total = Sum(45)m =		1927.5450	

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

29.9914	26.3901	27.7271	23.6710	22.4589	19.7102	19.0825	20.1439	20.6984	23.7093	25.9753	29.5737	(46)

Water storage loss:
Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.5520 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8381 (55)
Total storage loss

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

If cylinder contains dedicated solar storage

25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(57)

Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

249.1853	220.4115	234.0898	205.4609	198.9689	179.0558	176.4593	183.5353	185.6434	207.3045	220.8226	246.4005	(62)

WWHRS	-28.2888	-25.0189	-26.1983	-21.6933	-20.2173	-17.3001	-16.2161	-17.2442	-17.8994	-21.1014	-23.9053	-27.7650	(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

220.8965	195.3926	207.8915	183.7677	178.7515	161.7557	160.2432	166.2911	167.7440	186.2031	196.9172	218.6355	(64)

Total per year (kWh/year) = Sum(64)m = 2244.4896 (64)
12Total per year (kWh/year) 2244 (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

105.8751	94.0799	100.8558	90.5941	89.1781	81.8144	81.6937	84.0464	84.0048	91.9497	95.7018	104.9491	(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	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	112.3062	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.7867	110.4781	99.7867	103.1129	99.7867	103.1129	99.7867	99.7867	103.1129	99.7867	103.1129	99.7867	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	197.2971	199.3444	194.1852	183.2019	169.3374	156.3068	147.6015	145.5542	150.7134	161.6967	175.5612	188.5918	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	34.2306	(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)	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	-89.8450	(71)
Water heating gains (Table 5)	142.3052	139.9999	135.5589	125.8251	119.8630	113.6311	109.8033	112.9656	116.6733	123.5883	132.9192	141.0606	(72)
Total internal gains	499.0808	509.5142	489.2226	471.8318	448.6790	429.7426	413.8833	414.9983	427.1914	444.7635	471.2851	489.1310	(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	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825	(75)
Southwest	6.3000	36.7938	0.6300	0.7000	0.7700	70.8414	(79)
Northwest	4.2000	11.2829	0.6300	0.7000	0.7700	14.4825	(81)

Solar gains	99.8064	179.6283	271.3304	379.0257	463.6375	477.4822	453.1870	387.4336	308.2111	205.4178	121.2972	84.2798	(83)
Total gains	598.8872	689.1425	760.5530	850.8575	912.3165	907.2248	867.0703	802.4320	735.4025	650.1813	592.5823	573.4107	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	65.5193	65.6740	65.8263	66.5514	66.6889	67.3362	67.3362	67.4575	67.0854	66.6889	66.4114	66.1238	
alpha	5.3680	5.3783	5.3884	5.4368	5.4459	5.4891	5.4891	5.4972	5.4724	5.4459	5.4274	5.4083	
util living area	0.9895	0.9771	0.9483	0.8602	0.6986	0.5030	0.3654	0.4112	0.6512	0.9018	0.9771	0.9915	(86)
MIT	19.9935	20.1926	20.4553	20.7628	20.9367	20.9911	20.9987	20.9976	20.9670	20.7317	20.3156	19.9604	(87)
Th 2	20.0337	20.0358	20.0378	20.0473	20.0490	20.0573	20.0573	20.0589	20.0541	20.0490	20.0454	20.0417	(88)
util rest of house	0.9863	0.9705	0.9336	0.8255	0.6406	0.4317	0.2876	0.3281	0.5732	0.8681	0.9692	0.9889	(89)
MIT 2	18.8816	19.1332	19.4585	19.8231	20.0007	20.0527	20.0569	20.0581	20.0342	19.7998	19.2978	18.8457	(90)
Living area fraction										fLA = Living area / (4) =		0.2500	(91)
MIT	19.1596	19.3981	19.7077	20.0580	20.2347	20.2873	20.2924	20.2930	20.2674	20.0328	19.5522	19.1244	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1596	19.3981	19.7077	20.0580	20.2347	20.2873	20.2924	20.2930	20.2674	20.0328	19.5522	19.1244	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9824	0.9649	0.9276	0.8259	0.6524	0.4494	0.3071	0.3489	0.5914	0.8675	0.9639	0.9855	(94)
Useful gains	588.3335	664.9292	705.4706	702.7264	595.2378	407.6642	266.2746	279.9685	434.9376	564.0183	571.2058	565.0916	(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	1102.4855	1073.1317	975.3577	815.0142	622.1139	410.5767	266.5594	280.5343	446.8969	687.5791	911.4649	1097.1700	(97)
Space heating kWh	382.5291	274.3121	200.7960	80.8472	19.9959	0.0000	0.0000	0.0000	0.0000	91.9293	244.9866	395.8663	(98a)
Space heating requirement - total per year (kWh/year)												1691.2624	
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	382.5291	274.3121	200.7960	80.8472	19.9959	0.0000	0.0000	0.0000	0.0000	91.9293	244.9866	395.8663	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1691.2624	
Space heating per m2											(98c) / (4) =	24.1609	(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	382.5291	274.3121	200.7960	80.8472	19.9959	0.0000	0.0000	0.0000	0.0000	91.9293	244.9866	395.8663	(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)	414.4411	297.1962	217.5471	87.5918	21.6640	0.0000	0.0000	0.0000	0.0000	99.5983	265.4243	428.8909	(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	220.8965	195.3926	207.8915	183.7677	178.7515	161.7557	160.2432	166.2911	167.7440	186.2031	196.9172	218.6355	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2792	84.8205	83.9820	82.3500	80.6221	79.8000	79.8000	79.8000	79.8000	82.5659	84.5507	85.3742	(217)
Fuel for water heating, kWh/month	259.0275	230.3600	247.5431	223.1544	221.7153	202.7013	200.8060	208.3848	210.2056	225.5207	232.8983	256.0909	(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	20.7337	16.6333	14.9765	10.9724	8.4754	6.9245	7.7315	10.0498	13.0536	17.1271	19.3450	21.3099	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-32.8628	-46.3936	-66.7895	-75.2326	-81.2599	-75.9138	-74.9840	-70.7210	-63.2183	-53.1142	-36.1539	-28.4051	(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	-18.3841	-38.6929	-76.9341	-115.5884	-152.8672	-153.5928	-151.7771	-128.4913	-94.1621	-55.3395	-24.5486	-14.5357	(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	1832.3537	(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	2718.4078	(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)	167.3328	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1729.9627	(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	3074.1316	(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	1832.3537	0.2100	384.7943	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2718.4078	0.2100	570.8656	(264)
Space and water heating			955.6599	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	167.3328	0.1443	24.1513	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-705.0487	0.1345	-94.8620	
PV Unit electricity exported	-1024.9140	0.1259	-129.0243	
Total			-223.8863	(269)
Total CO2, kg/year			767.8541	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.9700	(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	1832.3537	1.1300	2070.5597	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2718.4078	1.1300	3071.8008	(278)
Space and water heating			5142.3605	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	167.3328	1.5338	256.6606	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-705.0487	1.4973	-1055.6411	
PV Unit electricity exported	-1024.9140	0.4621	-473.6077	
Total			-1529.2488	(283)
Total Primary energy kWh/year			3999.8731	(286)
Target Primary Energy Rate (TPER)			57.1400	(287)

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