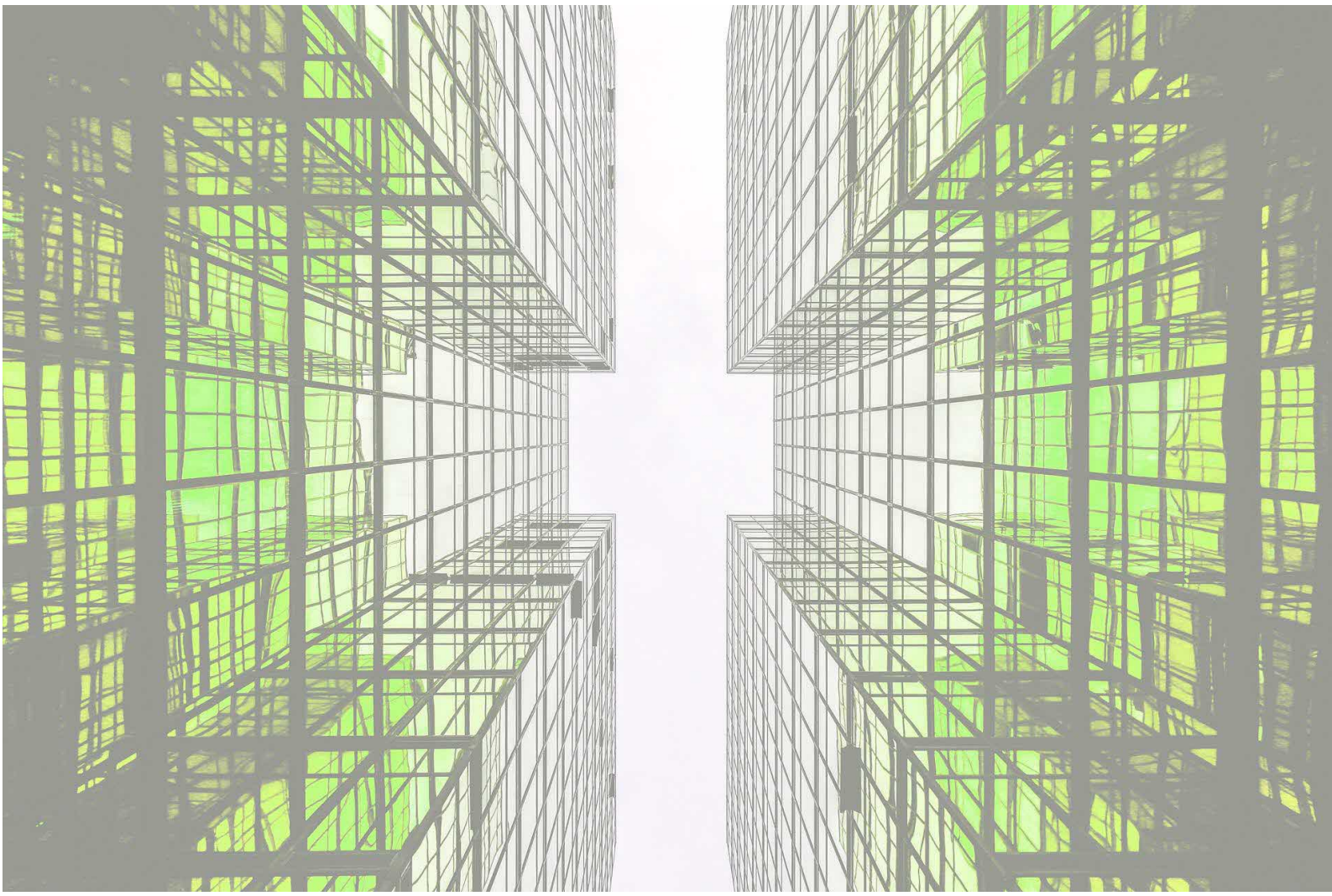
Sustainable Design & Construction Statement

Land off Sturt Avenue, Haslemere

Prepared for Casa Coveo
30th November 2023



envision

Revision	Date
A	14th July 2021
B	30th November

Author	Signature
Sam Wallis BSc (Hons) M Arch Sc OCDEA	[redacted]
Hayden Shipp BEng (Hons)	[redacted]
Quality Assurance Check	**Signature**
Simon Rainsford BSc MSc	[redacted]

London Office 0207 486 0680 **Oxford Office 01865 598098**

contact@envisioneco.com

CONTENTS

EXECUTIVE SUMMARY

1. This Sustainable Design and Construction Statement, incorporating an Energy Assessment has been prepared by Envision on behalf Casa Coveo (The Applicant) and is submitted in support of a full planning application for residential development comprising 9 dwelling houses together with associated access, infrastructure, parking and landscaping on land off Sturt Avenue in Haslemere, Surrey.

2. The primary purpose of this document is to explain how the scheme can meet Chichester District Council's energy and sustainability policies. Envision has undertaken a review of the relevant policies and worked with the design team to determine and agree the relevance and approach that should be taken to fulfil each policy.

3. The applicant has previously submitted the scheme however has now submitted the application with an amended site boundary. Since the time of the first submission, national building regulations have changed. This assessment has been updated to provide appropriate calculations based on new compliance software and demonstrating improvements from Part L 2021.

Summary of Sustainability Strategy

4. Sustainability has been a key consideration for the applicant from the outset, and the design has evolved to address a wide range of sustainability criteria with exemplar levels of performance in key areas. The scheme will deliver a series of sustainability measures that generally exceed the requirements of the Chichester Local Plan, as follows:

   The development will be fully electrified, futureproofed for decarbonisation and will achieve an overall 70.56% reduction in carbon emissions through the application of:

   i. Building fabric construction U-values significantly improved compared with standard Building Regulations U-values;

   ii. Reduced Air Permeability, lower than standard Buildings Regulations;

   iii. HVAC system controls to ensure installed equipment will be operating efficiently and automatic monitoring and targeting with alarms for out-of-range values;

   iv. High efficiency LED lighting utilising low-energy control systems such as daylight dimming and occupancy sensing;

   v. Mechanical Ventilation with Heat Recovery (MVHR) to each dwelling;

   vi. Reduction in solar gain through the specification of glazing with low g-values;

   vii. High-efficient Air-Source Heat Pumps providing efficient space and water heating to each dwelling; and

   viii. Roof mounted PV installations, in total generating 24,000 kWh of renewable electricity per annum.

   Incorporation of climate adaptation measures, including water efficient sanitaryware, SuDs measures, landscaping and passive building design, plus Mechanical Ventilation Heat Recovery to help mitigate overheating and increase efficiency;

A comprehensive Ecological Enhancement strategy to mitigate losses in biodiversity, including new habitats, hedgerow and bird and bat roosting features;

Sustainable material selections with timber to be procured with Forest Stewardship Council accreditation and the main contractor to adopt best practice measures to reduce water and energy use through construction;

The development of a Site Waste Management Plan to ensure waste generation is minimised during construction;

All dwellings on-site will make use of all-electric heating and hot water systems, reducing the impact on local air-quality;

Development of sustainable procurement plan by contractor to maximise the environmental performance of chosen materials;

Water conservation measures within the units to comply with 110 litres / bedspace per day.

5. The development is considered to comply with the sustainability requirements outlined by Chichester District Council sustainability and energy policies.

1 INTRODUCTION

1.1 Envision has been appointed by Casa Coveo (the Applicant) to produce a Sustainable Design and Construction Statement, incorporating an Energy Assessment in support of a detailed planning application for residential development comprising 9 dwelling houses together with associated access, infrastructure, parking and landscaping on land off Sturt Avenue in Haslemere, Surrey.

Scope

1.2 The primary purpose of this statement is to explain how best practice sustainable design and construction measures would be incorporated in the proposed development to ensure alignment with local planning policy.

1.3 The report sets the parameters of detailed design but remains at a strategic level. The calculations in this document are an indication of system size and carbon emissions based on guidance documents, approved software and practical experience. They are not design calculations but establish the viability and feasibility of various technologies for the proposed development.

1.4 This statement is structured as follows:

Section 1 provides a description of the site and the development proposals;

Section 2 provides a description of the main energy and sustainability policies relevant to the application;

Section 3 provides a summary of the sustainable design measures incorporated into the design;

Section 4 provides a concluding summary;

Appendix I contains an Energy Assessment.

Site Location & Proposed Development

1.5 The Site is situated to the north side of Sturt Avenue and is accessed by a private road at the east end of Sturt Avenue within the Camelsdale area. The site is located approximately 1.5km southwest of Haslemere.

1.6 The Site is bound to the south by the rear of existing properties fronting on to Sturt Avenue, to the east by the Thames Water pumping station and to the north and west by a mixture of residential properties and open fields. A stream, which is a branch of the River Wey, runs in a south-north alignment to the east side of the site.

1.7 The general proposal is for the redevelopment of the site for a residential-led development, which will involve the and construction of 9 new dwellings, and extensive landscaping strategy and associated ground and infrastructure works.

Fig 1.1 – Proposed Site Layout

2 SUSTAINABILITY & ENERGY POLICY CONTEXT

2.1 Many definitions of sustainable development exist, although the common objective for all is the integration of economic, social and environmental issues to ensure a better quality of life for people today, without compromising the needs of future generations. A key mechanism for delivering the principles of sustainable development lies within the UK planning system, which is implemented through national guidance and local planning policies. A review of all the relevant policy documents was undertaken in order to gain an understanding of the guiding policies for sustainability.

National Planning Policy Framework

2.2 The National Planning Policy Framework was updated on 5 September 2023 and sets out the government's planning policies for England and how these are expected to be applied. The NPPF sets out a presumption in favour of sustainable development, and the need to support economic growth through the planning system. Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

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

2.3 The NPPF notes that the planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

2.4 Furthermore, the NPPF sets out how local authority development plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures.

Chichester District Council Planning Policy

2.5 Chichester District Council is working to its new local plan (Chichester Local Plan: Key Policies 2014 – 2029) which was formally adopted by the council in July 2015.

2.6 The key policy within the local plan relevant to the sustainability and energy performance of new development is:

Policy 40 – Sustainable Design & Construction

2.7 For all new dwellings or for new non-domestic buildings, evidence will be required by the developer to demonstrate that all of the following criteria have been considered (proportionate to the scale of development):

1. How the proposal aims to protect and enhance the environment, both built and natural. Where this is not possible, how any harm will be mitigated;
2. The proposal achieves a minimum of 110 litres per person per day including external water use;
3. New development complies with Building for Life Standards or equivalent replacement national minimum standards, whichever are higher by ensuring it is accessible to all, flexible towards future adaptation in response to changing life needs, easily accessible to facilities and services; and takes into account the need for on-site waste reduction and recycling
4. Where appropriate, the proposals apply sound sustainable design, good environmental practices, sustainable building techniques and technology, including the use of materials that reduce the embodied carbon of construction and the use of re-used or recycled materials;
5. Energy consumption will be minimised and the amount of energy supplied from renewable resources will be maximised to meet the remaining requirement, including the use of energy efficient passive solar design principles where possible;
6. The proposals include measures to adapt to climate change, such as the provision of green infrastructure, sustainable urban drainage systems, suitable shading of pedestrian routes and open spaces and drought resistant planting/landscaping;
7. The historic and built environment, open space, and landscape character will be protected and enhanced;
8. The natural environment and biodiversity will be protected and/or where appropriate provision will be made for improvements to biodiversity areas and green infrastructure;
9. The development is appropriate and sympathetic in terms of scale, height, appearance, form, siting and layout and is sensitively designed to maintain the tranquillity and local character and identity of the area; and
10. The reduction of the impacts associated with traffic or pollution (including air, water, noise and light pollution) will be achieved, including but not limited to the promotion of car clubs and facilities for charging electric vehicles.

3 SUSTAINABLE DESIGN & CONSTRUCTION STATEMENT

3.1 This section provides an account of the sustainability benefits of the proposed development, and how relevant policy will be addressed in the development proposals. The section is structured against the headline sustainability themes within the Chichester Local Plan, along with wider sustainability considerations for a development site of this nature.

Energy and CO_2 Reduction

3.2 Policy 40 (5) of the Chichester Local Plan requires development to demonstrate how; "Energy consumption will be minimised and the amount of energy supplied from renewable resources will be maximised to meet the remaining requirement, including the use of energy efficient passive solar design principles where possible"

3.3 An Energy Assessment has been prepared and is included in Appendix I which explains how the development has prioritised the application of energy efficient design measures before the application of renewable technology.

3.4 The energy assessment has been undertaken using software recognised under the National Calculation Method (NCM) which have been applied by Envision to consider how the relevant targets can be met.

3.5 The applicant has sought to demonstrate exemplar levels of CO_2 reduction for the development site. The strategy presented in Appendix I for the development is expected to achieve an 70.56% reduction in sitewide CO_2 emissions beyond a Part L 2021 baseline, calculated using Design SAP 10 Elmhurst calculation software

3.6 The reductions proposed for the development are attributed to design features which reduce the consumption of energy. These are outlined further in the appended Energy Assessment, but include;

1. Optimised glazing;
2. Thermally efficient building fabrics;
3. Efficient lighting;
4. Low air permeability;
5. The use of Mechanical Ventilation Heat Recovery (MVHR);
6. Use of renewable heat pumps providing efficient space and water heating to the domestic and non-domestic uses; and
7. Photovoltaic arrays.

Climate Adaptation Strategy

3.7 According to the UK Climates Impact Programme, the inevitable consequences of climate change will be higher levels of winter rainfall have, often in increasingly heavy rainfall events leading to more flooding and damage to buildings and infrastructure, as well as hotter and dryer summers, leading to heat stress and drought. Annual average UK temperature was 0.9°C higher during the period 2005-2014 compared with 1961-1990. In addition to carbon reduction, there is a need to ensure that the built environment is adaptable and resilient to the projected risks.

3.8 Policy 40 (6) of the Chichester Local Plan requires development to demonstrate how; "The proposals include measures to adapt to climate change, such as the provision of green infrastructure, sustainable urban drainage systems, suitable shading of pedestrian routes and open spaces and drought resistant planting/landscaping".

3.9 In order to mitigate potential adverse effects from climate change, the following climate adaptation measures will be incorporated into the design:

Table 3.1– Climate Change Adaptation Measures

Identified Risk	Design Measure
Water Stress	The south of England is one of the driest parts of the country. Climate change is likely to reduce the amount of annual rainfall received, making water conservation a longer-term priority for Chichester District Council. Through detail-design the applicant will seek to ensure water efficiency is prioritised through the careful specification of sanitaryware. Included in Appendix IV is a water calculation with an indicative specification used to demonstrate a route to a water consumption of 108 l/p/day, meeting with Policy 40 (2) of the Chichester Local Plan. This specification will be passed to tendering contractors for review and incorporation into the scheme during detail-design.
Flood Risk	A Flood Risk and Drainage Assessment has been prepared with the application, prepared by Scott White & Hookins. Flood risk has been considered from all sources. According to the SWH report, Flood plain mapping provided by the EA indicate that the site lies in Flood Zone 1. The Strategic Flood Risk Assessment (SFRA) from Chichester Borough Council indicates that for the site there is a low risk to the north eastern boundary of the site adjacent to the River Wey where flooding from Surface Water could occur. No risk from groundwater or sewerage infrastructure flooding was identified. These identified risks are considered to be small, therefore the site is not considered to be at risk of fluvial or tidal flooding and will not require mitigation against these sources of flooding.
Increased Rainfall	The proposed SuDs system will accommodate surface water runoff for all storm events up to and including the 1 in 100yr + 40% allowance for climate change. The proposed system will utilise an attenuation tank with a flow control device located to the northern side of the site. A traditional drainage system will connect to the attenuation tank. A Hydrobrake will be fitted to the outflow of the attenuation tank. This will be limited to a maximum flow of 18.2l/s.
Drought	Drought can lead to increases in dust alongside degradation in external landscaping. No irrigation system is proposed for the site alterations and landscape irrigation will be via rainfall and manual watering where required to help landscaping establish.

Identified Risk	Design Measure
High Winds	Materials used will be durable and connection details designed to withstand wind / storm events. Landscaping specifications will be robust and account for high wind and storm events.

Ecology & Biodiversity

3.10 An Ecological Impact Assessment (encompassing Phase 1 Habitat Survey) has been prepared by the Ecological Co-Op and included with the application.

3.11 The proposed development will see the loss of 0.46ha of priority woodland habitat. In the absence of compensation this would result in a certain, permanent adverse effect on the ecology of the site. In order to mitigate this loss, and to provide an overall 10% net-gain in biodiversity (through off-site compensation), the following ecological enhancement measures are proposed:

Table 3.2– Ecological Enhancement

Measure	Description
Ecological Buffer Zone	The retained 5m wide buffer zone along the northern and north-western site boundaries will be sown with a woodland seed mix (Emorsgate EW1 – woodland mixture).
Hedgerow Creation	The proposed development will see the planting of at least 220m of new hedgerow habitat. These hedgerows will comprise of native species. These new species-rich hedgerows will use only native species from UK stock and include at least 6 species, with at least 50% of the new hedgerow comprising blackthorn Prunus spinosa or hawthorn Crategous monogyna to remain consistent with a traditional hedge and provide a good hedge structure.
Tree Planting	New trees will be planted within the development and within the ecological buffer zone along the north-western and north-eastern boundaries (number of trees to be confirmed). The landscaping plan will incorporate a variety of trees with most species to be UK natives sourced from UK stock. This will create greater habitat for a variety of birds and invertebrates.
Off-site Enhancement	Off-site habitat creation will be required to compensate for the loss of 2.8 Habitat Units. An overall gain of 3.193 Biodiversity Units will be provided to compensate for the habitat loss as well as achieving a 10% net gain in biodiversity.
Bats	As a measure to enhance roosting opportunities for bats, 'built in' roosting features will be incorporated into the new dwellings at the site.
Birds	To enhance the site for nesting birds, a total of nine integrated swift nest boxes and nine integrated house sparrow nest boxes will be integrated into the new buildings within the site.
Invertebrates	New deadwood habitat will be incorporated within areas of retained grassland at the southern and western edge of the development site. These areas of deadwood will provide an enhancement for a variety of saproxylic invertebrates including stag beetles (as well hibernating amphibians and reptiles).

3.12 The ecological enhancement measures proposed will ensure an overall 10% net-gain in biodiversity (including through off-site compensation) is achieved, thereby aligning with Policy 40 (8) of the Chichester Local Plan.

Materials

3.13 Maximising the sustainability of all the materials used in the build will be an important factor from the outset. The design team will commit to the following criteria to ensure as low an environmental impact as possible;

1. Materials Specification

Where possible building materials will be selected to minimise environmental impact. Examples of measures that will be considered include the use of recycled materials in concrete aggregates, albeit this will be subject to further feasibility testing during detailed design.

2. Procuring Materials Responsibility

Following the appointment of the main contractor, consideration will be given to the responsible sourcing of main construction materials. The contractor will be required to operate a Sustainable Procurement Plan and their suppliers will preferentially hold an Environmental Management System (EMS), and where possible accredited to ISO 140001. In addition, all timber in the scheme will be FSC and procured in accordance with the UK Government's 'Timber Procurement Policy'.

3. Designing for Durability and Resilience

The design of the building will ensure protection of exposed elements, therefore minimising the frequency of replacement and maximising materials optimisation. This will include measures to protect damage in areas of high pedestrian and vehicular traffic.

Waste

3.14 This section has considered all the requirements set out under Policy 40 (3) of the Chichester Local Plan which requires development proposals to; "take into account the need for on-site waste reduction and recycling".

3.15 Waste, both through construction and building operation, can have a detrimental effect on a building's overall sustainability and environmental performance. In lieu of this, the Government's "Our Waste, Our Resources: A Strategy for England (2018)" document sets targets to reduce the amount of waste going to landfill sites.

Construction Waste

3.16 Principles of the Waste Hierarchy will be reflected during the site clearing and enabling works phase – this will include an auditing by the demolition contractor in order to fully evaluate opportunities for reusing excavation materials on-site.

3.17 Targets will be established within a Site Waste Management Plan which accords with the Government's waste strategy, with targets to be set during the detail-design phase.

Operational Waste

3.18 Residential waste storage space would take account of the requirement of BS5906:2005. This requires that suitable refuse and recycling space provision is allocated for each property. The necessary provision is as follows:

100 litres for first bed;

70 litres for the second and third beds

3.19 In accordance with storage requirements in BS5906:2005, 50% of this quantity of waste arisings should be for recyclable waste and 75% of the quantity should be for general municipal waste. This over provision of storage capacity will ensure that sufficient space is always allocated to cater for waste volumes.

3.20 Each dwelling has been provided with a dedicated bin store with adequate provision allocated for refuse and recycling materials meeting the council's guidance with the bin store enclosed so as to minimise odour and noise.

Sustainable Transport

3.21 Sustainable transport promotes the use of public transport, cycling and walking in advance of private car use. The site is favourably located for accessibility with good standard footways in the vicinity of the site with comprehensive street lighting. There is continuous footway provision from the site into the centre of Haslemere and the surrounding areas, including Haslemere train station, located 1.5 km from the site. There is a marked cycle lane / track along King's Road on the northern side of the carriageway which leads to Haslemere Leisure Centre.

3.22 A Transport Assessment and Travel Plan have been developed by Pulsar Transport Planning. The scheme will include travel plan measures, including:

1. Cycle parking will be provided in accordance with best practice standards, with two provided per dwelling;
2. Although vehicles no larger than vans are intended for delivery and servicing, the internal site design will ensure that vehicles can turn around and egress in forward gear;
3. The proposed car parking provision is in accordance with Chichester's current parking standards, which states that a maximum of 3 parking spaces should be provided for 4-bed dwellings.

Pollution

3.23 Any new development can potentially lead to detrimental environmental effects; as is the nature of construction. These potential effects have been considered during the planning stages of this proposal. The development is not of the scale that would require an Environmental Impact Assessment (EIA), however the measures as outlined in this section, and subsequently implemented, will ensure that any potential impacts can be appropriately controlled.

Air Quality

3.24 During demolition the contractor will be required to follow best practices for the control of dust. Dust will be reduced by wetting down the site periodically during dry weather. In addition, sheeting on the scaffold will stop dust from the high levels permeating to the outside. The road will be swept regularly and muck away lorries will be checked and cleaned prior to their departure from site.

3.25 The proposed development works towards air quality neutral principles. The development does not propose any combustion on site as part of the energy strategy, making use of entirely electric systems for heating and hot water, as well as electric vehicle charging.

External Lighting

3.26 The development's lighting strategy will ensure that it does not have adverse effects at night-time. Respecting the existing nature of the site, the general site is within a suburban area and would be expected to be classified as being within Zone E3 – Suburban Area, characterised as having 'Medium district brightness' according to the Institute of Lighting Engineers Guidance Notes for the Reduction of Obtrusive Light (2011). The scheme proposes limited external lighting, and will minimise light pollution in accordance with the following criteria:

External lighting will be designed in compliance with Table 1 and accompanying notes of ILE Guidance Note for reduction of obtrusive light.

All non-safety/security lighting will be automatically switched off between 2300hrs and 0700hrs.

Sustainable Construction

3.27 The construction phase of the development can have a significant effect on the quality of the site and its surroundings, including the local environment, neighbouring residents, surrounding employees and the general public. Sustainable construction involves the prudent use of existing and new resources, the efficient management of the construction process, and consideration of potential adverse environmental impacts on local sensitive receptors.

3.28 It is not considered that the construction phase will yield an adverse level of disturbance, although various measures adopted by the contractor will ensure that any potential disturbance is minimised. The principal contractor will be required to deliver high standards of sustainable construction, which will be achieved through the following:

Registering the site against the Considerate Constructors Scheme; and

Managing the construction site to reduce environmental effects, this will include adopting best practice measures to protect water and air quality, monitoring water and energy use from construction activities.

4 CONCLUSION

4.1 Sustainability has been a key consideration for the applicant from the outset, and the design has evolved to address a wide range of sustainability criteria with exemplar levels of performance in key areas. The scheme will deliver a series of sustainability measures that meet and exceed the policy requirements of the Chichester Local Plan Policy 40 – Sustainable Design & Construction, this includes:

The development will be fully electrified, futureproofed for decarbonisation and will achieve an overall 70.56% reduction in carbon emissions.

High-efficient Air-Source Heat Pumps will be installed, providing efficient space and water heating to each dwelling.

Renewable energy will be generated on site. Roof mounted PV installations are proposed, in total generating 24,000 kWh of renewable electricity per annum.

The scheme will incorporate climate adaptation measures, including water efficient sanitaryware, sustainable drainage measures, green infrastructure and passive building design.

A comprehensive Ecological Enhancement strategy is proposed to mitigate losses in biodiversity, which taken together will demonstrate biodiversity net gain;

Sustainable material selections with timber to be procured with Forest Stewardship Council accreditation and the main contractor to adopt best practice measures to reduce water and energy use through construction;

Electric vehicle charging, enabling low carbon transport solutions for future residents.

4.2 The development is considered to comply with the sustainability requirements outlined by Chichester District Council sustainability and energy policy.

APPENDIX I – ENERGY ASSESSMENT

A1.1 Policy 40 (4) of the Chichester Local Plan requires development to demonstrate how; "Energy consumption will be minimised and the amount of energy supplied from renewable resources will be maximised to meet the remaining requirement, including the use of energy efficient passive solar design principles where possible"

Methodology

A1.2 The appropriate methodology for calculating the development's energy performance is "The Government's Standard Assessment Procedure for Energy Rating of Dwellings". This procedure was undertaken using Elmhurst SAP 10 version 2.12.2 which is a DCLG approved software and methodology for undertaking SAP assessments to ensure compliance with Part L1A of the Building Regulations.

A1.3 For the purposes of this energy assessment, each dwelling on-site was modelled using SAP with the assessment structured as follows:

1. Step 1 – Establish the Target Emission Rate

   This is the carbon emissions baseline against which proposed measures will show a reduction. It will be based on typical and benchmark Target Emission Rates for chosen dwelling types for unregulated carbon emissions as required by building regulations

2. Step 2 – Reducing Energy Requirements (Building Regulations Compliance)

   This will set out a range of energy-saving design measures in order to demonstrate a route to compliance with Part L of Building Regulations.

Step 1 - Establishing the Target Emission Rate (TER)

A1.4 The total emissions savings calculated in this report are expressed against a Building Regulation 2013 Target Emission Rate. This is the Baseline against which the measures implemented must show an improvement.

A1.5 The Target Emission Rates for the development have been established using CLG approved methodology and software. The calculated carbon emissions for the Target Emission Rates are illustrated overleaf.

A1.6 The calculated carbon emissions and total energy demand for the Target Emission Rate for building type 1 are illustrated below. The calculated figure demonstrates a Part L 2021 compliant model.

Table A1.1 – Target CO_2 emissions

	TFA for Unit Type (m^2)	Part L 2021 TER	Total Target CO_2 ($kg.CO_2.yr$)	Target Regulated Energy (kWh.yr)	TFEE	Total Target Fabric Efficiency
House Type A	803.2	10.76	8,642.43	13,267.33	49.92	40,095.74
House Type B	885.05	9.93	8,788.55	11,033.95	45.83	40,561.84
		Total =	17,430.98	24,301.27		80,657.59

A1.7 The figure of 17,430.98 $kg.CO_2$.annum is the target that must be reached and improved upon by the proposals in this Energy Assessment in order to comply with Building Regulations Volume 1, 2021, along with Policy 40 (4) of the Chichester Local Plan.

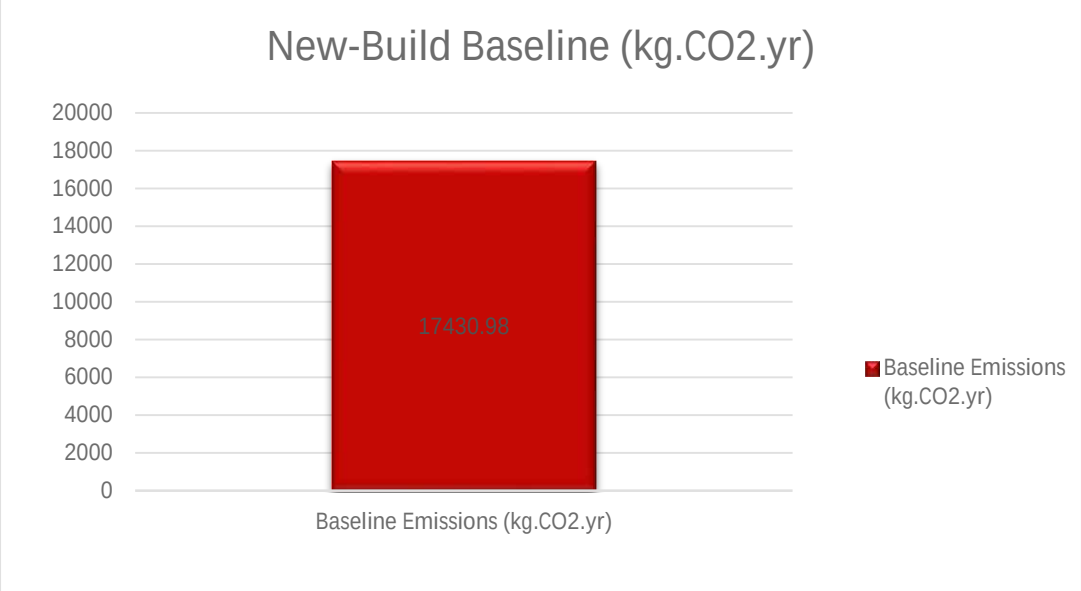


Fig A1.1 – Target CO_2 emissions

Step 2 – Reducing Energy Requirements

A1.8 Robust passive design requires buildings to follow a 'fabric first' approach. This is achieved through buildings using less energy by improving u-values, air-tightness and lighting efficiency amongst others. This is the first step to consider in reducing a building's carbon emissions before the efficient delivery of power, heat or renewables are considered by a design-team.

Fabric Efficiency

A1.9 U-Values are used to measure how effective elements of a buildings fabric are as insulators. That is, how effective they are at preventing heat from transmitting between the inside and the outside of a building. The lower the U-value of an element of a building's fabric, the more slowly heat is able to transmit through it, and so the better it performs as an insulator. Very broadly, the better (i.e., lower) the U-value of a buildings fabric, the less energy is required to maintain comfortable conditions inside the building. The following U Values and PSI values are proposed in order to comply with Building Regulations 2021.

Table A1.2 Proposed U-Values

Elements	U-Values – W/m^2 K	Comment
External Wall	0.16	n/a
Ground Floor	0.11	Including exposed floor at first floor level
External Roof	0.11	n/a
Standard Window Units	1.1	Assumed as double-glazed, argon-filled with a g-value of 0.53, and a frame factor of 0.85.
External Solid Doors	1.8	n/a

A1.3 Proposed PSI-Values

Thermal Bridging Element	Target PSI Value (W/m2K)
E2	0.3
E3	0.04
E4	0.05
E5	0.16
E6	0.07
E8	0.1
E14	0.08
E16	0.09
E17	-0.09
E20	0.32

Air Permeability

A1.10 The designed Air Permeability Rate (APR) has been set at 3 $m^3/h.m^2$ @ 50Pa.

Ventilation

A1.11 Mechanical Ventilation with Heat Recovery (MVHR) can maximise the recirculation of available warm air and reduce the space heating demand from the heating system, thereby lowering carbon emissions.

A1.12 At this stage the following balanced whole-house mechanical ventilation systems with heat recovery has been proposed[1]:

1. House Type A & B: Nuaire MRXBOXAB-ECO3.

A1.13 In order to reduce heat losses from excessively lengthy exhaust and intake ducting to the external wall, all MVHR units in each dwelling will be located within close proximity to the outside.

Lighting

A1.14 The SAP calculation software used for assessing the development does not allow for the specification of lighting elements. However, in order to reduce the potential for excessive lighting load, all lighting is to be LED with a minimum efficiency of 85 lamp lumens/circuit watt.

Heating and Hot water

A1.15 The proposed heating and for both the development is an air-source heat pump (ASHP), with each terraced house and apartment to have its own unit. ASHPs with the following specifications have been assumed for the development;

The ASHP will have a minimum SCOP of 2.9 for heating ;

Each dwelling will have a dedicated hot water cylinder, sized as followed:

- Houses: 300 litre cylinder with 1.89kWh/Day heat loss

HVAC system controls installed will be operating efficiently and to include automatic monitoring and targeting with alarms for out of range values as well as local time and temperature control.

Photovoltaics

A1.16 The second low-carbon/renewable energy proposed for the development is a Photovoltaic (PV) array. The proposed PV array will be mounted at the uppermost roof level of each house. The building design will provide service riser accommodation to allow the roof mounted inverter to be wired back to a distribution board and G59 intake meter arrangement in each dwelling.

[1] These system selections are indicative and subject to review and technical design.

A1.17 The carbon offset from the installation will contribute towards an overall developments CO_2 reduction. Included in the table below is a break-down of the PV requirements:

Table A1.4 – PV Array Details per Dwelling

Unit	PV Area per unit	PV Peak Power (kWp) per unit	PV Energy Generation (kWh.annum) per unit
House Type A	19.14 m²	3.74 kWp	2,844 kWh
House Type B	17.4 m²	3.4 kWp	2,585 kWh
Total Across Development	164m²	32 kWp	24,305 kWh[2]

Step 2 – Predicted CO_2 Reductions

A1.18 The following tables and graphs represent the Step 2 improvements for the proposed development against the Part L 2021 Target Emission Rate (TER) following the application of CO_2 reduction measures:

Table A1.5 Predicted CO_2 Reductions

Unit	Total Floor Area for Unit Type (m²)	Part L 2021 DER	Total CO_2 (kg.CO_2.yr)	Regulated Energy (kWh.yr)	DFEE	Total Dwelling Fabric Efficiency
House Type A	803.2	3.05	10,948.94	12,892.03	48.92	39,292.54
House Type B	885.05	13.34	11,806.84	11,114.43	44.82	39,667.94
		Total =	5,131.46	7,403.62		78,960.49
		Difference over Baseline	12299.52	16897.6553		1697.1005
		% Difference	70.56%	69.53%		2.10%

A1.19 As seen above, the energy efficient design measures taken in Step 2 will result in a 70.56% reduction in carbon emissions compared to the Part L 2021 baseline.

[2] This is the electrical generation requirement to be passed through to PV supplier.

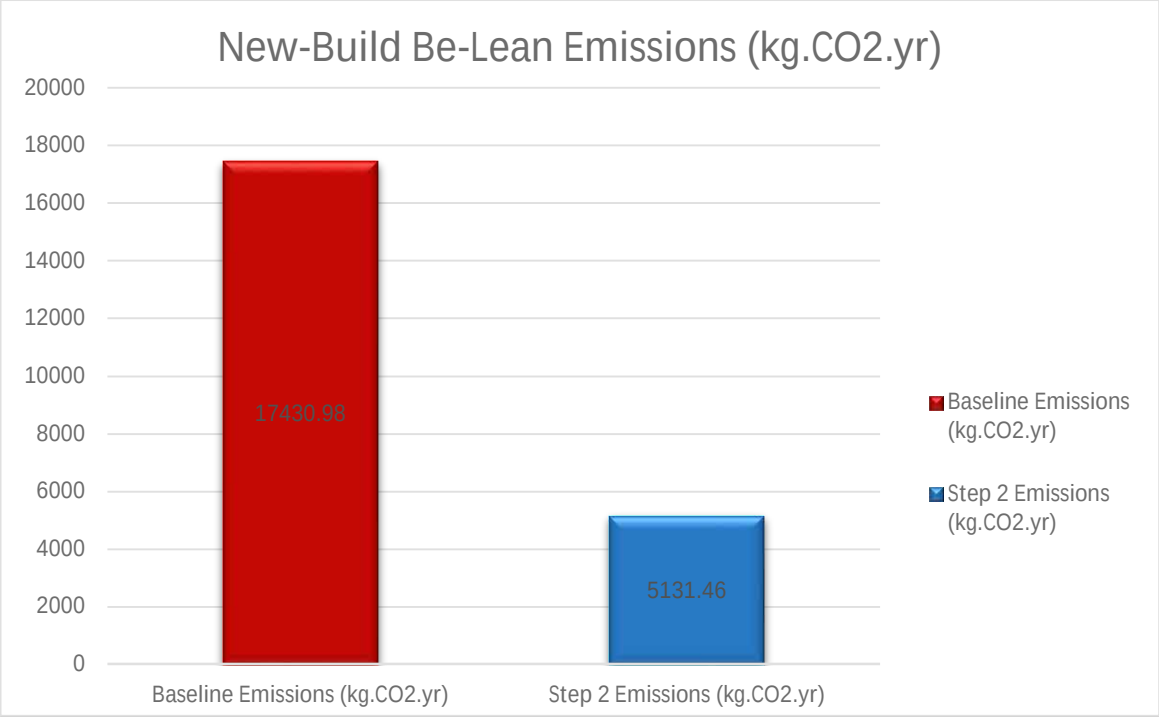


Fig A1.2 – Step 2 Emissions

APPENDIX II – SAP SUMMARY SHEETS

Full SAP Calculation Printout

Property Reference	House A - SAP 10	**Issued on Date**	29/11/2023
Assessment Reference	001	**Prop Type Ref**	House A (Energy Efficient)
Property			

SAP Rating	86 B	**DER**	3.05	**TER**	10.76
Environmental	97 A	**% DER < TER**			71.65
CO_2 Emissions (t/year)	0.45	**DFEE**	48.92	**TFEE**	49.92
Compliance Check	See BREL	**% DFEE < TFEE**			2.02
% DPER < TPER	45.61	**DPER**	30.87	**TPER**	56.75

Assessor Details	Mr. Sam Wallis	**Assessor ID**	BA56-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	93.8000 (1b)	x	3.0000 (2b)	=	281.4000 (1b) - (3b)	
First floor	107.0000 (1c)	x	2.6000 (2c)	=	278.2000 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	200.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	559.6000	(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			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1500 (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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Balanced mechanical ventilation with heat recovery

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

Effective ac	0.2952	0.2915	0.2877	0.2690	0.2652	0.2465	0.2465	0.2427	0.2540	0.2652	0.2727	0.2802	(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	
Front Door			2.3400	1.8000	4.2120			(26)
NW (Uw = 1.10)			55.5500	1.0536	58.5297			(27)
GF			93.8000	0.1100	10.3180			(28a)
Exposed Floor			13.2000	0.1100	1.4520			(28b)
Ext Wall	250.0000	57.8900	192.1100	0.1600	30.7376			(29a)
Flat Roof	107.0000		107.0000	0.1100	11.7700			(30)
Total net area of external elements Aum(A, m2)			464.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		117.0193			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	170.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	27.4500	0.3000	8.2350
E3 Sill	24.5800	0.0400	0.9832

E4 Jamb	50.6000	0.0500	2.5300	
E5 Ground floor (normal)	93.8800	0.1600	15.0208	
E6 Intermediate floor within a dwelling	93.8800	0.0700	6.5716	
E8 Balcony within a dwelling, wall insulation continuous	7.1500	0.1000	0.7150	
E14 Flat roof	107.3000	0.0800	8.5840	
E16 Corner (normal)	70.8000	0.0900	6.3720	
E17 Corner (inverted – internal area greater than external area)	35.4000	-0.0900	-3.1860	
E20 Exposed floor (normal)	13.4200	0.3200	4.2944	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 50.1200 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 167.1393 (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	54.5232	53.8307	53.1382	49.6757	48.9832	45.5207	45.5207	44.8282	46.9057	48.9832	50.3682	51.7532	(38)
Heat transfer coeff	221.6625	220.9700	220.2775	216.8150	216.1225	212.6600	212.6600	211.9675	214.0450	216.1225	217.5075	218.8925	(39)
Average = Sum(39)m / 12 =												216.6419	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1039	1.1004	1.0970	1.0798	1.0763	1.0591	1.0591	1.0556	1.0660	1.0763	1.0832	1.0901	(40)
HLP (average)												1.0789	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0030 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	102.5333	100.9924	98.7470	94.4509	91.2805	87.7449	85.7353	87.9637	90.4064	94.2025	98.5909	102.1404	(42a)
Hot water usage for baths	32.1906	31.7125	31.0393	29.7980	28.8685	27.8379	27.2811	27.9497	28.6776	29.7804	31.0473	32.0818	(42b)
Hot water usage for other uses	45.3833	43.7330	42.0827	40.4324	38.7821	37.1318	37.1318	38.7821	40.4324	42.0827	43.7330	45.3833	(42c)
Average daily hot water use (litres/day)												165.6356	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	180.1072	176.4379	171.8690	164.6813	158.9312	152.7146	150.1483	154.6954	159.5163	166.0656	173.3712	179.6055	(44)
Energy conte	285.2458	251.2453	264.1563	225.4405	213.9519	187.7804	181.5913	191.5453	196.6996	225.3495	246.9990	281.2188	(45)
Energy content (annual)										Total = Sum(45)m =		2751.2238	
Distribution loss (46)m = 0.15 x (45)m	42.7869	37.6868	39.6234	33.8161	32.0928	28.1671	27.2387	28.7318	29.5049	33.8024	37.0499	42.1828	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8900	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0206	(55)
Total storage loss	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(56)
If cylinder contains dedicated solar storage	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(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	340.1468	300.8333	319.0573	278.5705	268.8529	240.9104	236.4923	246.4463	249.8296	280.2505	300.1290	336.1198	(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	340.1468	300.8333	319.0573	278.5705	268.8529	240.9104	236.4923	246.4463	249.8296	280.2505	300.1290	336.1198	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		3397.6388	(64)
Electric shower(s)												3398	(64)
	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	138.7650	123.2095	131.7528	117.4630	115.0598	104.9410	104.2999	107.6096	107.9066	118.8495	124.6312	137.4261	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	187.5329	207.6257	187.5329	193.7840	187.5329	193.7840	187.5329	187.5329	193.7840	187.5329	193.7840	187.5329	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	371.8050	375.6632	365.9407	345.2427	319.1152	294.5591	278.1540	274.2959	284.0183	304.7163	330.8438	355.4000	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	(71)
Water heating gains (Table 5)	186.5121	183.3474	177.0871	163.1430	154.6503	145.7514	140.1880	144.6366	149.8703	159.7440	173.0989	184.7125	(72)
Total internal gains	813.8945	834.6807	798.6051	770.2142	729.3428	702.1389	673.9194	674.5098	695.7171	720.0376	765.7711	795.6898	(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	2.3400	11.2829	0.5500	0.8500	0.7700	8.5537	(75)
Southeast	5.7000	36.7938	0.5500	0.8500	0.7700	67.9461	(77)
Southwest	30.9400	36.7938	0.5500	0.8500	0.7700	368.8164	(79)
Northwest	16.5700	11.2829	0.5500	0.8500	0.7700	60.5703	(81)

Solar gains	505.8865	884.6720	1271.4333	1677.5900	1972.3445	1999.1229	1910.2882	1684.1136	1411.1007	994.1946	610.1167	430.2278	(83)

Total gains	1319.7810	1719.3528	2070.0384	2447.8041	2701.6873	2701.2617	2584.2077	2358.6234	2106.8177	1714.2322	1375.8878	1225.9176	(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	42.7777	42.9118	43.0467	43.7342	43.8743	44.5887	44.5887	44.7343	44.3001	43.8743	43.5949	43.3191	
alpha	3.8518	3.8608	3.8698	3.9156	3.9250	3.9726	3.9726	3.9823	3.9533	3.9250	3.9063	3.8879	
util living area													
	0.9878	0.9679	0.9253	0.8232	0.6662	0.4869	0.3580	0.4061	0.6389	0.8888	0.9743	0.9906	(86)
Living	19.2668	19.6303	20.0742	20.5576	20.8471	20.9665	20.9922	20.9874	20.9045	20.4730	19.7775	19.2138	
Non living	17.9763	18.4369	18.9896	19.5736	19.8889	20.0128	20.0312	20.0316	19.9594	19.4944	18.6371	17.9164	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.9977	20.0005	20.0033	20.0174	20.0202	20.0344	20.0344	20.0372	20.0287	20.0202	20.0146	20.0089	(88)
util rest of house													
	0.9850	0.9610	0.9098	0.7904	0.6135	0.4193	0.2813	0.3243	0.5672	0.8592	0.9676	0.9885	(89)
MIT 2	19.9977	20.0005	20.0033	20.0174	20.0202	20.0344	20.0344	20.0372	20.0287	20.0202	20.0146	20.0089	(90)
Living area fraction										fLA = Living area / (4) =		0.3817	(91)
MIT	20.3803	20.3820	20.3838	20.3925	20.3942	20.4030	20.4030	20.4048	20.3995	20.3942	20.3907	20.3872	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3803	20.3820	20.3838	20.3925	20.3942	20.4030	20.4030	20.4048	20.3995	20.3942	20.3907	20.3872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9862	0.9638	0.9161	0.8036	0.6344	0.4456	0.3108	0.3559	0.5957	0.8714	0.9704	0.9894	(94)
Useful gains	1301.5352	1657.1078	1896.3559	1967.0316	1713.8167	1203.6140	803.2250	839.5363	1254.9799	1493.7593	1335.1571	1212.9050	(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													
	3564.3935	3421.0605	3058.2787	2491.7422	1879.0186	1234.0646	808.7447	848.8769	1348.3731	2116.7534	2890.8341	3543.2657	(97)
Space heating kWh													
	1683.5666	1185.3762	864.4706	377.7916	122.9103	0.0000	0.0000	0.0000	0.0000	463.5076	1120.0874	1733.7884	(98a)
Space heating requirement - total per year (kWh/year)												7551.4987	
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													
	1683.5666	1185.3762	864.4706	377.7916	122.9103	0.0000	0.0000	0.0000	0.0000	463.5076	1120.0874	1733.7884	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7551.4987	
Space heating per m2											(98c) / (4) =	37.6071	(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 %)												339.9956	(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													
	1683.5666	1185.3762	864.4706	377.7916	122.9103	0.0000	0.0000	0.0000	0.0000	463.5076	1120.0874	1733.7884	(98)
Space heating efficiency (main heating system 1)													
	339.9956	339.9956	339.9956	339.9956	339.9956	0.0000	0.0000	0.0000	0.0000	339.9956	339.9956	339.9956	(210)
Space heating fuel (main heating system)													
	495.1730	348.6445	254.2593	111.1166	36.1505	0.0000	0.0000	0.0000	0.0000	136.3275	329.4417	509.9443	(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													
	340.1468	300.8333	319.0573	278.5705	268.8529	240.9104	236.4923	246.4463	249.8296	280.2505	300.1290	336.1198	(64)
Efficiency of water heater												119.3400	(216)
(217)m	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	(217)
Fuel for water heating, kWh/month													
	285.0233	252.0808	267.3515	233.4260	225.2831	201.8690	198.1668	206.5077	209.3427	234.8337	251.4907	281.6489	(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	69.5805	62.8469	69.5805	67.3360	69.5805	67.3360	69.5805	69.5805	67.3360	69.5805	67.3360	69.5805	(231)
Lighting	42.0738	33.7532	30.3910	22.2658	17.1987	14.0515	15.6892	20.3935	26.4891	34.7551	39.2558	43.2432	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-56.5465	-103.2216	-193.4375	-268.6606	-325.5011	-313.6201	-307.4014	-269.5031	-205.7074	-134.7040	-68.6591	-45.8630	(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												2221.0575	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												119.3400	
Water heating fuel used												2847.0243	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.6000, SFP = 1.2000)		
mechanical ventilation fans (SFP = 1.2000)		819.2544 (230a)
Total electricity for the above, kWh/year		819.2544 (231)
Electricity for lighting (calculated in Appendix L)		339.5600 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-2292.8254 (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		3934.0708 (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	2221.0575	0.1564	347.4667	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2847.0243	0.1410	401.5245	(264)
Space and water heating			748.9912	(265)
Pumps, fans and electric keep-hot	819.2544	0.1387	113.6407	(267)
Energy for lighting	339.5600	0.1443	49.0090	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2292.8254	0.1308	-299.9126	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-299.9126	(269)
Total CO2, kg/year			611.7283	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0500	(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	2221.0575	1.5791	3507.3582	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2847.0243	1.5215	4331.7357	(278)
Space and water heating			7839.0939	(279)
Pumps, fans and electric keep-hot	819.2544	1.5128	1239.3681	(281)
Energy for lighting	339.5600	1.5338	520.8284	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2292.8254	1.4832	-3400.7708	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-3400.7708	(283)
Total Primary energy kWh/year			6198.5196	(286)
Dwelling Primary energy Rate (DPER)			30.8700	(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	93.8000 (1b)	x	3.0000 (2b)	=	281.4000	(1b) - (3b)
First floor	107.0000 (1c)	x	2.6000 (2c)	=	278.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 200.8000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	559.6000	(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) =	0.0715	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3215	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3215	(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													
	0.4099	0.4018	0.3938	0.3536	0.3456	0.3054	0.3054	0.2974	0.3215	0.3456	0.3617	0.3777	(22b)
Effective ac	0.5840	0.5807	0.5775	0.5625	0.5597	0.5466	0.5466	0.5442	0.5517	0.5597	0.5654	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			2.3400	1.0000	2.3400			(26)
TER Opening Type (Uw = 1.20)			47.8700	1.1450	54.8130			(27)
GF			93.8000	0.1300	12.1940			(28a)
Exposed Floor			13.2000	0.1300	1.7160			(28b)
Ext Wall	250.0000	50.2100	199.7900	0.1800	35.9622			(29a)
Flat Roof	107.0000		107.0000	0.1100	11.7700			(30)
Total net area of external elements Aum(A, m2)			464.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.7952			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 170.0000 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	27.4500	0.0500	1.3725
E3	Sill	24.5800	0.0500	1.2290
E4	Jamb	50.6000	0.0500	2.5300
E5	Ground floor (normal)	93.8800	0.1600	15.0208
E6	Intermediate floor within a dwelling	93.8800	0.0000	0.0000
E8	Balcony within a dwelling, wall insulation continuous	7.1500	0.0000	0.0000
E14	Flat roof	107.3000	0.0800	8.5840
E16	Corner (normal)	70.8000	0.0900	6.3720
E17	Corner (inverted – internal area greater than external area)	35.4000	-0.0900	-3.1860
E20	Exposed floor (normal)	13.4200	0.3200	4.2944

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 36.2167 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 155.0119 (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	107.8468	107.2444	106.6539	103.8806	103.3617	100.9462	100.9462	100.4989	101.8766	103.3617	104.4114	105.5088	(38)
Heat transfer coeff													
	262.8586	262.2563	261.6658	258.8925	258.3736	255.9581	255.9581	255.5108	256.8885	258.3736	259.4233	260.5207	(39)
Average = Sum(39)m / 12 =												258.8900	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3091	1.3061	1.3031	1.2893	1.2867	1.2747	1.2747	1.2725	1.2793	1.2867	1.2919	1.2974	(40)
HLP (average)												1.2893	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0030 (42)

Hot water usage for mixer showers

74.5696	73.4490	71.8160	68.6916	66.3858	63.8145	62.3529	63.9736	65.7501	68.5109	71.7025	74.2839	(42a)

Hot water usage for baths

32.1906	31.7125	31.0393	29.7980	28.8685	27.8379	27.2811	27.9497	28.6776	29.7804	31.0473	32.0818	(42b)

Hot water usage for other uses

45.3833	43.7330	42.0827	40.4324	38.7821	37.1318	37.1318	38.7821	40.4324	42.0827	43.7330	45.3833	(42c)

Average daily hot water use (litres/day) 139.8541 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	152.1436	148.8946	144.9380	138.9220	134.0365	128.7842	126.7659	130.7054	134.8601	140.3740	146.4828	151.7490	(44)
Energy conte	240.9582	212.0239	222.7644	190.1773	180.4388	158.3552	153.3124	161.8405	166.2959	190.4863	208.6916	237.6023	(45)
Energy content (annual)										Total = Sum(45)m =		2322.9468	
Distribution loss (46)m = 0.15 x (45)m													
	36.1437	31.8036	33.4147	28.5266	27.0658	23.7533	22.9969	24.2761	24.9444	28.5729	31.3037	35.6404	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1127	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1409	(55)
Total storage loss													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage													
	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(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													
	299.5871	264.9789	281.3932	246.9148	239.0677	215.0927	211.9412	220.4693	223.0335	249.1151	265.4291	296.2312	(62)
WWHRS	-34.0901	-30.1496	-31.5709	-26.1420	-24.3634	-20.8479	-19.5416	-20.7805	-21.5701	-25.4287	-28.8076	-33.4588	(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													
	265.4969	234.8293	249.8223	220.7729	214.7043	194.2448	192.3996	199.6888	201.4635	223.6864	236.6215	262.7723	(64)
										Total per year (kWh/year) = Sum(64)m =		2696.5025	(64)
12Total per year (kWh/year)												2697	(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													
	127.0217	112.8620	120.9722	108.6240	106.8990	98.0431	97.8794	100.7150	100.6835	110.2397	114.7800	125.9058	(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	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	(66)

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

	187.5329	207.6257	187.5329	193.7840	187.5329	193.7840	187.5329	187.5329	193.7840	187.5329	193.7840	187.5329	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.8050	375.6632	365.9407	345.2427	319.1152	294.5591	278.1540	274.2959	284.0183	304.7163	330.8438	355.4000	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	(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)													
	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	(71)
Water heating gains (Table 5)													
	170.7280	167.9494	162.5971	150.8667	143.6814	136.1710	131.5584	135.3697	139.8381	148.1717	159.4167	169.2283	(72)
Total internal gains													
	801.1104	822.2827	787.1151	760.9378	721.3740	692.5585	665.2897	665.2429	685.6849	711.4653	755.0889	783.2056	(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	2.0200	11.2829	0.6300	0.7000	0.7700	6.9654	(75)
Southeast	4.9100	36.7938	0.6300	0.7000	0.7700	55.2113	(77)
Southwest	26.6600	36.7938	0.6300	0.7000	0.7700	299.7830	(79)
Northwest	14.2800	11.2829	0.6300	0.7000	0.7700	49.2405	(81)

Solar gains	411.2002	719.0954	1033.4868	1363.6591	1603.2789	1625.0562	1552.8399	1368.9709	1147.0248	808.1241	495.9230	349.7017	(83)
Total gains	1212.3106	1541.3781	1820.6019	2124.5969	2324.6528	2317.6147	2218.1296	2034.2138	1832.7097	1519.5895	1251.0119	1132.9073	(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	36.0735	36.1563	36.2379	36.6261	36.6997	37.0460	37.0460	37.1108	36.9118	36.6997	36.5512	36.3972	
alpha	3.4049	3.4104	3.4159	3.4417	3.4466	3.4697	3.4697	3.4741	3.4608	3.4466	3.4367	3.4265	
util living area													
	0.9909	0.9793	0.9559	0.8971	0.7878	0.6279	0.4827	0.5381	0.7627	0.9338	0.9827	0.9928	(86)
MIT	18.8065	19.1324	19.5851	20.1522	20.6047	20.8732	20.9615	20.9440	20.7404	20.1231	19.3584	18.7566	(87)
Th 2	19.8337	19.8361	19.8384	19.8492	19.8512	19.8607	19.8607	19.8625	19.8571	19.8512	19.8471	19.8429	(88)
util rest of house													
	0.9887	0.9744	0.9451	0.8714	0.7354	0.5404	0.3683	0.4209	0.6866	0.9118	0.9777	0.9910	(89)
MIT 2	17.2873	17.7025	18.2741	18.9772	19.4994	19.7770	19.8449	19.8372	19.6609	18.9596	18.0002	17.2293	(90)
Living area fraction										fLA = Living area / (4) =		0.3817	(91)
MIT	17.8672	18.2483	18.7746	19.4257	19.9213	20.1954	20.2712	20.2597	20.0730	19.4037	18.5187	17.8123	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8672	18.2483	18.7746	19.4257	19.9213	20.1954	20.2712	20.2597	20.0730	19.4037	18.5187	17.8123	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9831	0.9649	0.9322	0.8602	0.7390	0.5677	0.4110	0.4638	0.7026	0.9009	0.9695	0.9863	(94)
Useful gains	1191.8260	1487.3359	1697.1043	1827.4775	1717.8232	1315.6508	911.5528	943.4381	1287.6279	1368.9310	1212.8218	1117.3568	(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													
	3566.2634	3500.6862	3211.8301	2725.0303	2124.1706	1432.2003	939.6626	986.1870	1534.3861	2274.6497	2962.2639	3546.2811	(97)
Space heating kWh													
	1766.5814	1352.9714	1126.9560	646.2380	302.3224	0.0000	0.0000	0.0000	0.0000	673.8547	1259.5983	1807.1197	(98a)
Space heating requirement - total per year (kWh/year)												8935.6420	
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													
	1766.5814	1352.9714	1126.9560	646.2380	302.3224	0.0000	0.0000	0.0000	0.0000	673.8547	1259.5983	1807.1197	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8935.6420	
Space heating per m2											(98c) / (4) =	44.5002	(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													
	1766.5814	1352.9714	1126.9560	646.2380	302.3224	0.0000	0.0000	0.0000	0.0000	673.8547	1259.5983	1807.1197	(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)													
	1913.9560	1465.8412	1220.9708	700.1495	327.5433	0.0000	0.0000	0.0000	0.0000	730.0701	1364.6786	1957.8761	(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													
	265.4969	234.8293	249.8223	220.7729	214.7043	194.2448	192.3996	199.6888	201.4635	223.6864	236.6215	262.7723	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.5105	87.3431	87.0192	86.3210	84.8271	79.8000	79.8000	79.8000	79.8000	86.3723	87.2439	87.5465	(217)
Fuel for water heating, kWh/month													
	303.3886	268.8584	287.0888	255.7580	253.1080	243.4145	241.1022	250.2366	252.4605	258.9793	271.2183	300.1516	(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	38.9656	31.2597	28.1459	20.6209	15.9282	13.0134	14.5302	18.8869	24.5322	32.1876	36.3558	40.0486	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-79.7882	-108.6515	-150.8518	-163.5308	-171.2104	-157.7856	-155.5701	-149.1533	-137.3910	-121.0172	-86.2279	-69.4164	(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	-57.5535	-119.3805	-234.3276	-347.8696	-456.2501	-457.2922	-452.1496	-384.7358	-284.3886	-169.6387	-76.4547	-45.6649	(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	9681.0856	(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	3185.7650	(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)	314.4750	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4636.3002	(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	8631.0254	(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	9681.0856	0.2100	2033.0280	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3185.7650	0.2100	669.0106	(264)
Space and water heating			2702.0386	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	314.4750	0.1443	45.3885	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1550.5943	0.1354	-209.9178	
PV Unit electricity exported	-3085.7058	0.1262	-389.5113	
Total			-599.4291	(269)
Total CO2, kg/year			2159.9272	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7600	(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	9681.0856	1.1300	10939.6267	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3185.7650	1.1300	3599.9144	(278)
Space and water heating			14539.5411	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	314.4750	1.5338	482.3523	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1550.5943	1.5004	-2326.4832	
PV Unit electricity exported	-3085.7058	0.4634	-1429.8179	
Total			-3756.3011	(283)
Total Primary energy kWh/year			11395.6931	(286)
Target Primary Energy Rate (TPER)			56.7500	(287)

Full SAP Calculation Printout

Property Reference	House A - SAP 10	**Issued on Date**	29/11/2023
Assessment Reference	001	**Prop Type Ref**	House A (Energy Efficient)
Property			

SAP Rating	77 C	**DER**	4.54	**TER**	10.76
Environmental	95 A	**% DER < TER**			57.81
CO_2 Emissions (t/year)	0.79	**DFEE**	48.92	**TFEE**	49.92
Compliance Check	See BREL	**% DFEE < TFEE**			2.02
% DPER < TPER	15.76	**DPER**	47.81	**TPER**	56.75

Assessor Details	Mr. Sam Wallis	**Assessor ID**	BA56-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	93.8000 (1b)	x	3.0000 (2b)	=	281.4000 (1b) - (3b)	
First floor	107.0000 (1c)	x	2.6000 (2c)	=	278.2000 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	200.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	559.6000	(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			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1500 (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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Balanced mechanical ventilation with heat recovery

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

Effective ac	0.2952	0.2915	0.2877	0.2690	0.2652	0.2465	0.2465	0.2427	0.2540	0.2652	0.2727	0.2802	(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	
Front Door			2.3400	1.8000	4.2120			(26)
NW (Uw = 1.10)			55.5500	1.0536	58.5297			(27)
GF			93.8000	0.1100	10.3180			(28a)
Exposed Floor			13.2000	0.1100	1.4520			(28b)
Ext Wall	250.0000	57.8900	192.1100	0.1600	30.7376			(29a)
Flat Roof	107.0000		107.0000	0.1100	11.7700			(30)
Total net area of external elements Aum(A, m2)			464.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		117.0193			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	170.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	27.4500	0.3000	8.2350
E3 Sill	24.5800	0.0400	0.9832

E4 Jamb	50.6000	0.0500	2.5300	
E5 Ground floor (normal)	93.8800	0.1600	15.0208	
E6 Intermediate floor within a dwelling	93.8800	0.0700	6.5716	
E8 Balcony within a dwelling, wall insulation continuous	7.1500	0.1000	0.7150	
E14 Flat roof	107.3000	0.0800	8.5840	
E16 Corner (normal)	70.8000	0.0900	6.3720	
E17 Corner (inverted – internal area greater than external area)	35.4000	-0.0900	-3.1860	
E20 Exposed floor (normal)	13.4200	0.3200	4.2944	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 50.1200 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 167.1393 (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	54.5232	53.8307	53.1382	49.6757	48.9832	45.5207	45.5207	44.8282	46.9057	48.9832	50.3682	51.7532	(38)
Heat transfer coeff	221.6625	220.9700	220.2775	216.8150	216.1225	212.6600	212.6600	211.9675	214.0450	216.1225	217.5075	218.8925	(39)
Average = Sum(39)m / 12 =												216.6419	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1039	1.1004	1.0970	1.0798	1.0763	1.0591	1.0591	1.0556	1.0660	1.0763	1.0832	1.0901	(40)
HLP (average)												1.0789	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0030 (42)
Hot water usage for mixer showers

102.5333	100.9924	98.7470	94.4509	91.2805	87.7449	85.7353	87.9637	90.4064	94.2025	98.5909	102.1404	(42a)

Hot water usage for baths

32.1906	31.7125	31.0393	29.7980	28.8685	27.8379	27.2811	27.9497	28.6776	29.7804	31.0473	32.0818	(42b)

Hot water usage for other uses

45.3833	43.7330	42.0827	40.4324	38.7821	37.1318	37.1318	38.7821	40.4324	42.0827	43.7330	45.3833	(42c)

Average daily hot water use (litres/day) 165.6356 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	180.1072	176.4379	171.8690	164.6813	158.9312	152.7146	150.1483	154.6954	159.5163	166.0656	173.3712	179.6055	(44)
Energy conte	285.2458	251.2453	264.1563	225.4405	213.9519	187.7804	181.5913	191.5453	196.6996	225.3495	246.9990	281.2188	(45)
Energy content (annual)										Total = Sum(45)m =		2751.2238	

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

42.7869	37.6868	39.6234	33.8161	32.0928	28.1671	27.2387	28.7318	29.5049	33.8024	37.0499	42.1828	(46)

Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8900 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0206 (55)
Total storage loss

31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(56)

If cylinder contains dedicated solar storage

31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(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

340.1468	300.8333	319.0573	278.5705	268.8529	240.9104	236.4923	246.4463	249.8296	280.2505	300.1290	336.1198	(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

340.1468	300.8333	319.0573	278.5705	268.8529	240.9104	236.4923	246.4463	249.8296	280.2505	300.1290	336.1198	(64)
									Total per year (kWh/year) = Sum(64)m =		3397.6388	(64)
12Total per year (kWh/year)											3398	(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

138.7650	123.2095	131.7528	117.4630	115.0598	104.9410	104.2999	107.6096	107.9066	118.8495	124.6312	137.4261	(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	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	187.5329	207.6257	187.5329	193.7840	187.5329	193.7840	187.5329	187.5329	193.7840	187.5329	193.7840	187.5329	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	371.8050	375.6632	365.9407	345.2427	319.1152	294.5591	278.1540	274.2959	284.0183	304.7163	330.8438	355.4000	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	(71)
Water heating gains (Table 5)	186.5121	183.3474	177.0871	163.1430	154.6503	145.7514	140.1880	144.6366	149.8703	159.7440	173.0989	184.7125	(72)
Total internal gains	813.8945	834.6807	798.6051	770.2142	729.3428	702.1389	673.9194	674.5098	695.7171	720.0376	765.7711	795.6898	(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	2.3400	11.2829	0.5500	0.8500	0.7700	8.5537	(75)
Southeast	5.7000	36.7938	0.5500	0.8500	0.7700	67.9461	(77)
Southwest	30.9400	36.7938	0.5500	0.8500	0.7700	368.8164	(79)
Northwest	16.5700	11.2829	0.5500	0.8500	0.7700	60.5703	(81)

Solar gains 505.8865	884.6720	1271.4333	1677.5900	1972.3445	1999.1229	1910.2882	1684.1136	1411.1007	994.1946	610.1167	430.2278	(83)

Total gains	1319.7810	1719.3528	2070.0384	2447.8041	2701.6873	2701.2617	2584.2077	2358.6234	2106.8177	1714.2322	1375.8878	1225.9176	(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	42.7777	42.9118	43.0467	43.7342	43.8743	44.5887	44.5887	44.7343	44.3001	43.8743	43.5949	43.3191	
alpha	3.8518	3.8608	3.8698	3.9156	3.9250	3.9726	3.9726	3.9823	3.9533	3.9250	3.9063	3.8879	
util living area													
	0.9878	0.9679	0.9253	0.8232	0.6662	0.4869	0.3580	0.4061	0.6389	0.8888	0.9743	0.9906	(86)
Living	19.2668	19.6303	20.0742	20.5576	20.8471	20.9665	20.9922	20.9874	20.9045	20.4730	19.7775	19.2138	
Non living	17.9763	18.4369	18.9896	19.5736	19.8889	20.0128	20.0312	20.0316	19.9594	19.4944	18.6371	17.9164	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.9977	20.0005	20.0033	20.0174	20.0202	20.0344	20.0344	20.0372	20.0287	20.0202	20.0146	20.0089	(88)
util rest of house													
	0.9850	0.9610	0.9098	0.7904	0.6135	0.4193	0.2813	0.3243	0.5672	0.8592	0.9676	0.9885	(89)
MIT 2	19.9977	20.0005	20.0033	20.0174	20.0202	20.0344	20.0344	20.0372	20.0287	20.0202	20.0146	20.0089	(90)
Living area fraction										fLA = Living area / (4) =		0.3817	(91)
MIT	20.3803	20.3820	20.3838	20.3925	20.3942	20.4030	20.4030	20.4048	20.3995	20.3942	20.3907	20.3872	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3803	20.3820	20.3838	20.3925	20.3942	20.4030	20.4030	20.4048	20.3995	20.3942	20.3907	20.3872	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9862	0.9638	0.9161	0.8036	0.6344	0.4456	0.3108	0.3559	0.5957	0.8714	0.9704	0.9894	(94)
Useful gains	1301.5352	1657.1078	1896.3559	1967.0316	1713.8167	1203.6140	803.2250	839.5363	1254.9799	1493.7593	1335.1571	1212.9050	(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													
	3564.3935	3421.0605	3058.2787	2491.7422	1879.0186	1234.0646	808.7447	848.8769	1348.3731	2116.7534	2890.8341	3543.2657	(97)
Space heating kWh													
	1683.5666	1185.3762	864.4706	377.7916	122.9103	0.0000	0.0000	0.0000	0.0000	463.5076	1120.0874	1733.7884	(98a)
Space heating requirement - total per year (kWh/year)												7551.4987	
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													
	1683.5666	1185.3762	864.4706	377.7916	122.9103	0.0000	0.0000	0.0000	0.0000	463.5076	1120.0874	1733.7884	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7551.4987	
Space heating per m2											(98c) / (4) =	37.6071	(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 %)												339.9956	(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													
	1683.5666	1185.3762	864.4706	377.7916	122.9103	0.0000	0.0000	0.0000	0.0000	463.5076	1120.0874	1733.7884	(98)
Space heating efficiency (main heating system 1)													
	339.9956	339.9956	339.9956	339.9956	339.9956	0.0000	0.0000	0.0000	0.0000	339.9956	339.9956	339.9956	(210)
Space heating fuel (main heating system)													
	495.1730	348.6445	254.2593	111.1166	36.1505	0.0000	0.0000	0.0000	0.0000	136.3275	329.4417	509.9443	(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													
	340.1468	300.8333	319.0573	278.5705	268.8529	240.9104	236.4923	246.4463	249.8296	280.2505	300.1290	336.1198	(64)
Efficiency of water heater												119.3400	(216)
(217)m	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	(217)
Fuel for water heating, kWh/month													
	285.0233	252.0808	267.3515	233.4260	225.2831	201.8690	198.1668	206.5077	209.3427	234.8337	251.4907	281.6489	(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	69.5805	62.8469	69.5805	67.3360	69.5805	67.3360	69.5805	69.5805	67.3360	69.5805	67.3360	69.5805	(231)
Lighting	42.0738	33.7532	30.3910	22.2658	17.1987	14.0515	15.6892	20.3935	26.4891	34.7551	39.2558	43.2432	(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												2221.0575	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												119.3400	
Water heating fuel used												2847.0243	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.6000, SFP = 1.2000)
mechanical ventilation fans (SFP = 1.2000) 819.2544 (230a)
Total electricity for the above, kWh/year 819.2544 (231)
Electricity for lighting (calculated in Appendix L) 339.5600 (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 6226.8962 (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	2221.0575	0.1564	347.4667	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2847.0243	0.1410	401.5245	(264)
Space and water heating			748.9912	(265)
Pumps, fans and electric keep-hot	819.2544	0.1387	113.6407	(267)
Energy for lighting	339.5600	0.1443	49.0090	(268)
Total CO2, kg/year			911.6409	(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	2221.0575	1.5791	3507.3582	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2847.0243	1.5215	4331.7357	(278)
Space and water heating			7839.0939	(279)
Pumps, fans and electric keep-hot	819.2544	1.5128	1239.3681	(281)
Energy for lighting	339.5600	1.5338	520.8284	(282)
Total Primary energy kWh/year			9599.2904	(286)
Dwelling Primary energy Rate (DPER)			47.8100	(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	93.8000 (1b)	x	3.0000 (2b)	=	281.4000 (1b) - (3b)	
First floor	107.0000 (1c)	x	2.6000 (2c)	=	278.2000 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 200.8000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	559.6000	(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) =	0.0715 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3215 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3215 (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	0.4099	0.4018	0.3938	0.3536	0.3456	0.3054	0.3054	0.2974	0.3215	0.3456	0.3617	0.3777	(22b)
Effective ac	0.5840	0.5807	0.5775	0.5625	0.5597	0.5466	0.5466	0.5442	0.5517	0.5597	0.5654	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			2.3400	1.0000	2.3400			(26)
TER Opening Type (Uw = 1.20)			47.8700	1.1450	54.8130			(27)
GF			93.8000	0.1300	12.1940			(28a)
Exposed Floor			13.2000	0.1300	1.7160			(28b)
Ext Wall	250.0000	50.2100	199.7900	0.1800	35.9622			(29a)
Flat Roof	107.0000		107.0000	0.1100	11.7700			(30)
Total net area of external elements Aum(A, m2)			464.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.7952			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 170.0000 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	27.4500	0.0500	1.3725
E3	Sill	24.5800	0.0500	1.2290
E4	Jamb	50.6000	0.0500	2.5300
E5	Ground floor (normal)	93.8800	0.1600	15.0208
E6	Intermediate floor within a dwelling	93.8800	0.0000	0.0000
E8	Balcony within a dwelling, wall insulation continuous	7.1500	0.0000	0.0000
E14	Flat roof	107.3000	0.0800	8.5840
E16	Corner (normal)	70.8000	0.0900	6.3720
E17	Corner (inverted – internal area greater than external area)	35.4000	-0.0900	-3.1860
E20	Exposed floor (normal)	13.4200	0.3200	4.2944

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 36.2167 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 155.0119 (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	107.8468	107.2444	106.6539	103.8806	103.3617	100.9462	100.9462	100.4989	101.8766	103.3617	104.4114	105.5088	(38)
Heat transfer coeff	262.8586	262.2563	261.6658	258.8925	258.3736	255.9581	255.9581	255.5108	256.8885	258.3736	259.4233	260.5207	(39)

Average = Sum(39)m / 12 = 258.8900

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3091	1.3061	1.3031	1.2893	1.2867	1.2747	1.2747	1.2725	1.2793	1.2867	1.2919	1.2974	(40)
HLP (average)												1.2893	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0030 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	74.5696	73.4490	71.8160	68.6916	66.3858	63.8145	62.3529	63.9736	65.7501	68.5109	71.7025	74.2839	(42a)
Hot water usage for baths	32.1906	31.7125	31.0393	29.7980	28.8685	27.8379	27.2811	27.9497	28.6776	29.7804	31.0473	32.0818	(42b)
Hot water usage for other uses	45.3833	43.7330	42.0827	40.4324	38.7821	37.1318	37.1318	38.7821	40.4324	42.0827	43.7330	45.3833	(42c)

Average daily hot water use (litres/day) 139.8541 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	152.1436	148.8946	144.9380	138.9220	134.0365	128.7842	126.7659	130.7054	134.8601	140.3740	146.4828	151.7490	(44)
Energy conte	240.9582	212.0239	222.7644	190.1773	180.4388	158.3552	153.3124	161.8405	166.2959	190.4863	208.6916	237.6023	(45)
Energy content (annual)										Total = Sum(45)m =		2322.9468	
Distribution loss (46)m = 0.15 x (45)m	36.1437	31.8036	33.4147	28.5266	27.0658	23.7533	22.9969	24.2761	24.9444	28.5729	31.3037	35.6404	(46)

Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.1127 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1409 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(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	299.5871	264.9789	281.3932	246.9148	239.0677	215.0927	211.9412	220.4693	223.0335	249.1151	265.4291	296.2312	(62)
WWHRS	-34.0901	-30.1496	-31.5709	-26.1420	-24.3634	-20.8479	-19.5416	-20.7805	-21.5701	-25.4287	-28.8076	-33.4588	(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	265.4969	234.8293	249.8223	220.7729	214.7043	194.2448	192.3996	199.6888	201.4635	223.6864	236.6215	262.7723	(64)
										Total per year (kWh/year) = Sum(64)m =		2696.5025	(64)
12Total per year (kWh/year)												2697	(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	127.0217	112.8620	120.9722	108.6240	106.8990	98.0431	97.8794	100.7150	100.6835	110.2397	114.7800	125.9058	(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	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	150.1481	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	187.5329	207.6257	187.5329	193.7840	187.5329	193.7840	187.5329	187.5329	193.7840	187.5329	193.7840	187.5329	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	371.8050	375.6632	365.9407	345.2427	319.1152	294.5591	278.1540	274.2959	284.0183	304.7163	330.8438	355.4000	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	38.0148	(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)	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	-120.1184	(71)
Water heating gains (Table 5)	170.7280	167.9494	162.5971	150.8667	143.6814	136.1710	131.5584	135.3697	139.8381	148.1717	159.4167	169.2283	(72)

Total internal gains
801.1104 822.2827 787.1151 760.9378 721.3740 692.5585 665.2897 665.2429 685.6849 711.4653 755.0889 783.2056 (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	2.0200	11.2829	0.6300	0.7000	0.7700	6.9654 (75)
Southeast	4.9100	36.7938	0.6300	0.7000	0.7700	55.2113 (77)
Southwest	26.6600	36.7938	0.6300	0.7000	0.7700	299.7830 (79)
Northwest	14.2800	11.2829	0.6300	0.7000	0.7700	49.2405 (81)

Solar gains	411.2002	719.0954	1033.4868	1363.6591	1603.2789	1625.0562	1552.8399	1368.9709	1147.0248	808.1241	495.9230	349.7017 (83)
Total gains	1212.3106	1541.3781	1820.6019	2124.5969	2324.6528	2317.6147	2218.1296	2034.2138	1832.7097	1519.5895	1251.0119	1132.9073 (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	36.0735	36.1563	36.2379	36.6261	36.6997	37.0460	37.0460	37.1108	36.9118	36.6997	36.5512	36.3972	
alpha	3.4049	3.4104	3.4159	3.4417	3.4466	3.4697	3.4697	3.4741	3.4608	3.4466	3.4367	3.4265	
util living area	0.9909	0.9793	0.9559	0.8971	0.7878	0.6279	0.4827	0.5381	0.7627	0.9338	0.9827	0.9928	(86)
MIT	18.8065	19.1324	19.5851	20.1522	20.6047	20.8732	20.9615	20.9440	20.7404	20.1231	19.3584	18.7566	(87)
Th 2	19.8337	19.8361	19.8384	19.8492	19.8512	19.8607	19.8607	19.8625	19.8571	19.8512	19.8471	19.8429	(88)
util rest of house	0.9887	0.9744	0.9451	0.8714	0.7354	0.5404	0.3683	0.4209	0.6866	0.9118	0.9777	0.9910	(89)
MIT 2	17.2873	17.7025	18.2741	18.9772	19.4994	19.7770	19.8449	19.8372	19.6609	18.9596	18.0002	17.2293	(90)
Living area fraction									fLA = Living area / (4) =			0.3817	(91)
MIT	17.8672	18.2483	18.7746	19.4257	19.9213	20.1954	20.2712	20.2597	20.0730	19.4037	18.5187	17.8123	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8672	18.2483	18.7746	19.4257	19.9213	20.1954	20.2712	20.2597	20.0730	19.4037	18.5187	17.8123	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9831	0.9649	0.9322	0.8602	0.7390	0.5677	0.4110	0.4638	0.7026	0.9009	0.9695	0.9863	(94)
Useful gains	1191.8260	1487.3359	1697.1043	1827.4775	1717.8232	1315.6508	911.5528	943.4381	1287.6279	1368.9310	1212.8218	1117.3568	(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	3566.2634	3500.6862	3211.8301	2725.0303	2124.1706	1432.2003	939.6626	986.1870	1534.3861	2274.6497	2962.2639	3546.2811	(97)
Space heating kWh	1766.5814	1352.9714	1126.9560	646.2380	302.3224	0.0000	0.0000	0.0000	0.0000	673.8547	1259.5983	1807.1197	(98a)
Space heating requirement - total per year (kWh/year)												8935.6420	
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	1766.5814	1352.9714	1126.9560	646.2380	302.3224	0.0000	0.0000	0.0000	0.0000	673.8547	1259.5983	1807.1197	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8935.6420	
Space heating per m2											(98c) / (4) =	44.5002	(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	1766.5814	1352.9714	1126.9560	646.2380	302.3224	0.0000	0.0000	0.0000	0.0000	673.8547	1259.5983	1807.1197	(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)	1913.9560	1465.8412	1220.9708	700.1495	327.5433	0.0000	0.0000	0.0000	0.0000	730.0701	1364.6786	1957.8761	(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	265.4969	234.8293	249.8223	220.7729	214.7043	194.2448	192.3996	199.6888	201.4635	223.6864	236.6215	262.7723	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.5105	87.3431	87.0192	86.3210	84.8271	79.8000	79.8000	79.8000	79.8000	86.3723	87.2439	87.5465	(217)
Fuel for water heating, kWh/month	303.3886	268.8584	287.0888	255.7580	253.1080	243.4145	241.1022	250.2366	252.4605	258.9793	271.2183	300.1516	(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	38.9656	31.2597	28.1459	20.6209	15.9282	13.0134	14.5302	18.8869	24.5322	32.1876	36.3558	40.0486	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-79.7882	-108.6515	-150.8518	-163.5308	-171.2104	-157.7856	-155.5701	-149.1533	-137.3910	-121.0172	-86.2279	-69.4164	(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	-57.5535	-119.3805	-234.3276	-347.8696	-456.2501	-457.2922	-452.1496	-384.7358	-284.3886	-169.6387	-76.4547	-45.6649 (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	9681.0856 (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	3185.7650 (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)	314.4750 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-4636.3002 (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	8631.0254 (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	9681.0856	0.2100	2033.0280	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3185.7650	0.2100	669.0106	(264)
Space and water heating			2702.0386	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	314.4750	0.1443	45.3885	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1550.5943	0.1354	-209.9178	
PV Unit electricity exported	-3085.7058	0.1262	-389.5113	
Total			-599.4291	(269)
Total CO2, kg/year			2159.9272	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7600	(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	9681.0856	1.1300	10939.6267	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3185.7650	1.1300	3599.9144	(278)
Space and water heating			14539.5411	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	314.4750	1.5338	482.3523	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1550.5943	1.5004	-2326.4832	
PV Unit electricity exported	-3085.7058	0.4634	-1429.8179	
Total			-3756.3011	(283)
Total Primary energy kWh/year			11395.6931	(286)
Target Primary Energy Rate (TPER)			56.7500	(287)

Full SAP Calculation Printout

Property Reference	House B - SAP 10	**Issued on Date**	29/11/2023
Assessment Reference	001	**Prop Type Ref**	House B (Energy Efficient)
Property			

SAP Rating	86 B	**DER**	3.03	**TER**	9.93
Environmental	97 A	**% DER < TER**			69.49
CO_2 Emissions (t/year)	0.4	**DFEE**	44.82	**TFEE**	45.83
Compliance Check	See BREL	**% DFEE < TFEE**			2.22
% DPER < TPER	40.88	**DPER**	30.83	**TPER**	52.14

Assessor Details	Mr. Sam Wallis	**Assessor ID**	BA56-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	83.6800 (1b)	x	3.0000 (2b)	=	251.0400	(1b) - (3b)
First floor	93.3300 (1c)	x	2.6000 (2c)	=	242.6580	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	177.0100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	493.6980	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Balanced mechanical ventilation with heat recovery

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

Effective ac	0.2952	0.2915	0.2877	0.2690	0.2652	0.2465	0.2465	0.2427	0.2540	0.2652	0.2727	0.2802	(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	
Front Door			1.8200	1.8000	3.2760			(26)
N (Uw = 1.10)			36.9570	1.0536	38.9425			(27)
GF			83.6800	0.1100	9.2048			(28a)
Exposed Floor			9.7000	0.1100	1.0670			(28b)
Ext Wall	217.0000	38.7770	178.2230	0.1600	28.5157			(29a)
Flat Roof	93.3300		93.3300	0.1300	12.1329			(30)
Total net area of external elements Aum(A, m2)			403.7130					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.1389			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	170.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	18.6500	0.3000	5.5950
E3 Sill	14.5950	0.0400	0.5838

E3 Sill	28.1900	0.0500	1.4095
E5 Ground floor (normal)	83.6800	0.1600	13.3888
E20 Exposed floor (normal)	9.6200	0.3200	3.0784
E6 Intermediate floor within a dwelling	83.6800	0.0700	5.8576
E8 Balcony within a dwelling, wall insulation continuous	6.5720	0.0500	0.3286
E14 Flat roof	93.3000	0.0800	7.4640
E16 Corner (normal)	59.0000	0.0900	5.3100
E17 Corner (inverted – internal area greater than external area)	11.8000	-0.0900	-1.0620

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 41.9537 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 135.0926 (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	48.1022	47.4913	46.8803	43.8256	43.2146	40.1599	40.1599	39.5489	41.3818	43.2146	44.4365	45.6584	(38)
Heat transfer coeff	183.1948	182.5839	181.9729	178.9182	178.3072	175.2525	175.2525	174.6415	176.4744	178.3072	179.5291	180.7510	(39)
Average = Sum(39)m / 12 =												178.7654	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0349	1.0315	1.0280	1.0108	1.0073	0.9901	0.9901	0.9866	0.9970	1.0073	1.0142	1.0211	(40)
HLP (average)												1.0099	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9719 (42)
Hot water usage for mixer showers

130.8319	128.8658	126.0007	120.5189	116.4735	111.9621	109.3978	112.2412	115.3581	120.2020	125.8015	130.3307	(42a)

Hot water usage for baths

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

45.0650	43.4263	41.7876	40.1488	38.5101	36.8714	36.8714	38.5101	40.1488	41.7876	43.4263	45.0650	(42c)

Average daily hot water use (litres/day) 161.5909 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	175.8970	172.2921	167.7883	160.6678	154.9836	148.8335	146.2692	150.7513	155.5069	161.9895	169.2278	175.3957	(44)
Energy conte	278.5778	245.3416	257.8843	219.9461	208.6377	183.0081	176.8999	186.6616	191.7556	219.8182	241.0960	274.6273	(45)
Energy content (annual)										Total = Sum(45)m =		2684.2543	

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

41.7867	36.8012	38.6827	32.9919	31.2957	27.4512	26.5350	27.9992	28.7633	32.9727	36.1644	41.1941	(46)

Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8900 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0206 (55)
Total storage loss

31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(56)

If cylinder contains dedicated solar storage

31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(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

333.4788	294.9296	312.7853	273.0761	263.5387	236.1381	231.8009	241.5626	244.8856	274.7192	294.2260	329.5283	(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

333.4788	294.9296	312.7853	273.0761	263.5387	236.1381	231.8009	241.5626	244.8856	274.7192	294.2260	329.5283	(64)
									Total per year (kWh/year) = Sum(64)m =		3330.6693	(64)
12Total per year (kWh/year)											3331	(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

136.5479	121.2465	129.6673	115.6361	113.2928	103.3542	102.7400	105.9858	106.2627	117.0104	122.6684	135.2344	(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	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	175.8453	194.6859	175.8453	181.7068	175.8453	181.7068	175.8453	175.8453	181.7068	175.8453	181.7068	175.8453	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	348.6331	352.2508	343.1342	323.7262	299.2271	276.2013	260.8187	257.2010	266.3175	285.7255	310.2247	333.2504	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	(71)
Water heating gains (Table 5)	183.5321	180.4263	174.2841	160.6057	152.2753	143.5475	138.0914	142.4540	147.5871	157.2720	170.3728	181.7666	(72)
Total internal gains	775.5887	794.9412	760.8418	733.6169	694.9259	669.0338	642.3336	643.0785	663.1897	686.4211	729.8825	758.4406	(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	8.6770	10.6334	0.5500	0.8500	0.7700	29.8921	(74)
South	26.4600	46.7521	0.5500	0.8500	0.7700	400.7795	(78)
West	1.8200	19.6403	0.5500	0.8500	0.7700	11.5807	(80)

Solar gains	442.2523	736.1531	970.4816	1155.3095	1261.4472	1240.7787	1200.8424	1121.5777	1033.5093	802.8418	526.3759	380.7533	(83)
Total gains	1217.8410	1531.0943	1731.3235	1888.9264	1956.3731	1909.8126	1843.1761	1764.6562	1696.6990	1489.2629	1256.2584	1139.1939	(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	45.6280	45.7806	45.9343	46.7186	46.8787	47.6958	47.6958	47.8626	47.3655	46.8787	46.5596	46.2449	
alpha	4.0419	4.0520	4.0623	4.1146	4.1252	4.1797	4.1797	4.1908	4.1577	4.1252	4.1040	4.0830	
util living area	0.9853	0.9646	0.9296	0.8552	0.7333	0.5593	0.4119	0.4459	0.6554	0.8819	0.9694	0.9885	(86)
Living	19.7604	20.0080	20.2790	20.5790	20.7843	20.8923	20.9186	20.9159	20.8590	20.5844	20.1213	19.7251	
Non living	18.5996	18.9135	19.2524	19.6244	19.8559	19.9740	19.9934	19.9950	19.9412	19.6410	19.0708	18.5635	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.0543	20.0572	20.0600	20.0744	20.0772	20.0916	20.0916	20.0945	20.0859	20.0772	20.0715	20.0658	(88)
util rest of house	0.9821	0.9573	0.9152	0.8266	0.6843	0.4893	0.3298	0.3622	0.5867	0.8522	0.9618	0.9860	(89)
MIT 2	20.0543	20.0572	20.0600	20.0744	20.0772	20.0916	20.0916	20.0945	20.0859	20.0772	20.0715	20.0658	(90)
Living area fraction										fLA = Living area / (4) =		0.2610	(91)
MIT	20.3011	20.3033	20.3054	20.3160	20.3181	20.3287	20.3287	20.3308	20.3244	20.3181	20.3138	20.3096	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3011	20.3033	20.3054	20.3160	20.3181	20.3287	20.3287	20.3308	20.3244	20.3181	20.3138	20.3096	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9830	0.9593	0.9192	0.8346	0.6978	0.5081	0.3515	0.3844	0.6055	0.8606	0.9640	0.9867	(94)
Useful gains	1197.1512	1468.8437	1591.4673	1576.4776	1365.1767	970.3707	647.9084	678.4048	1027.3759	1281.7013	1210.9887	1124.0355	(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	2931.3268	2812.3861	2512.2032	2042.5217	1536.6652	1003.9699	653.4649	686.4873	1098.4558	1732.8031	2372.2681	2911.8264	(97)
Space heating kWh	1290.2266	902.8605	685.0275	335.5517	127.5874	0.0000	0.0000	0.0000	0.0000	335.6197	836.1211	1330.1165	(98a)
Space heating requirement - total per year (kWh/year)												5843.1112	
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	1290.2266	902.8605	685.0275	335.5517	127.5874	0.0000	0.0000	0.0000	0.0000	335.6197	836.1211	1330.1165	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5843.1112	
Space heating per m2											(98c) / (4) =	33.0101	(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 %) 335.9382 (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	1290.2266	902.8605	685.0275	335.5517	127.5874	0.0000	0.0000	0.0000	0.0000	335.6197	836.1211	1330.1165	(98)
Space heating efficiency (main heating system 1)	335.9382	335.9382	335.9382	335.9382	335.9382	0.0000	0.0000	0.0000	0.0000	335.9382	335.9382	335.9382	(210)
Space heating fuel (main heating system)	384.0667	268.7579	203.9148	99.8850	37.9794	0.0000	0.0000	0.0000	0.0000	99.9052	248.8914	395.9409	(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	333.4788	294.9296	312.7853	273.0761	263.5387	236.1381	231.8009	241.5626	244.8856	274.7192	294.2260	329.5283	(64)
Efficiency of water heater												119.3400	(216)
(217)m	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	(217)
Fuel for water heating, kWh/month	279.4359	247.1339	262.0960	228.8220	220.8302	197.8701	194.2357	202.4154	205.1999	230.1988	246.5443	276.1256	(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	61.3863	55.4457	61.3863	59.4061	61.3863	59.4061	61.3863	61.3863	59.4061	61.3863	59.4061	61.3863	(231)
Lighting	39.1953	31.4439	28.3118	20.7424	16.0220	13.0901	14.6158	18.9982	24.6768	32.3773	36.5701	40.2846	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-51.3738	-93.7509	-175.9197	-245.6913	-299.4146	-288.5648	-282.7752	-247.4354	-188.3392	-122.4966	-62.3699	-41.6707	(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 1739.3413 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 119.3400

Water heating fuel used 2790.9077 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.6000, SFP = 1.2000)

mechanical ventilation fans (SFP = 1.2000)	722.7739 (230a)
Total electricity for the above, kWh/year	722.7739 (231)
Electricity for lighting (calculated in Appendix L)	316.3284 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2099.8022 (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	3469.5490 (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	1739.3413	0.1563	271.8080	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2790.9077	0.1410	393.6145	(264)
Space and water heating			665.4225	(265)
Pumps, fans and electric keep-hot	722.7739	0.1387	100.2576	(267)
Energy for lighting	316.3284	0.1443	45.6560	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2099.8022	0.1307	-274.5221	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-274.5221	(269)
Total CO2, kg/year			536.8140	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0300	(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	1739.3413	1.5785	2745.5634	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2790.9077	1.5215	4246.3705	(278)
Space and water heating			6991.9338	(279)
Pumps, fans and electric keep-hot	722.7739	1.5128	1093.4123	(281)
Energy for lighting	316.3284	1.5338	485.1950	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2099.8022	1.4830	-3113.9370	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-3113.9370	(283)
Total Primary energy kWh/year			5456.6041	(286)
Dwelling Primary energy Rate (DPER)			30.8300	(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	83.6800 (1b)	x	3.0000 (2b)	=	251.0400	(1b) - (3b)
First floor	93.3300 (1c)	x	2.6000 (2c)	=	242.6580	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 177.0100						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	493.6980	(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) =	0.0810	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3310	(18)
Number of sides sheltered		0	(19)
Shelter factor (20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) =		0.3310	(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	0.4221	0.4138	0.4055	0.3641	0.3558	0.3145	0.3145	0.3062	0.3310	0.3558	0.3724	0.3889	(22b)
Effective ac	0.5891	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756	(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			1.8200	1.0000	1.8200			(26)
TER Opening Type (Uw = 1.20)			36.9570	1.1450	42.3206			(27)
GF			83.6800	0.1300	10.8784			(28a)
Exposed Floor			9.7000	0.1300	1.2610			(28b)
Ext Wall	217.0000	38.7770	178.2230	0.1800	32.0801			(29a)
Flat Roof	93.3300		93.3300	0.1100	10.2663			(30)
Total net area of external elements Aum(A, m2)			403.7130					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	98.6265			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 170.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	18.6500	0.0500	0.9325
E3 Sill	14.5950	0.0500	0.7298
E3 Sill	28.1900	0.0500	1.4095
E5 Ground floor (normal)	83.6800	0.1600	13.3888
E20 Exposed floor (normal)	9.6200	0.3200	3.0784
E6 Intermediate floor within a dwelling	83.6800	0.0000	0.0000
E8 Balcony within a dwelling, wall insulation continuous	6.5720	0.0000	0.0000
E14 Flat roof	93.3000	0.0800	7.4640
E16 Corner (normal)	59.0000	0.0900	5.3100
E17 Corner (inverted – internal area greater than external area)	11.8000	-0.0900	-1.0620

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 31.2509 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 129.8774 (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	95.9705	95.4070	94.8547	92.2606	91.7753	89.5159	89.5159	89.0975	90.3862	91.7753	92.7571	93.7836	(38)
Heat transfer coeff	225.8479	225.2844	224.7321	222.1380	221.6527	219.3933	219.3933	218.9749	220.2636	221.6527	222.6345	223.6610	(39)
Average = Sum(39)m / 12 =												222.1357	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2759	1.2727	1.2696	1.2549	1.2522	1.2394	1.2394	1.2371	1.2444	1.2522	1.2578	1.2636	(40)
HLP (average)												1.2549	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9719 (42)

Hot water usage for mixer showers

95.1505	93.7206	91.6369	87.6501	84.7080	81.4270	79.5620	81.6300	83.8968	87.4196	91.4920	94.7859	(42a)

Hot water usage for baths

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

45.0650	43.4263	41.7876	40.1488	38.5101	36.8714	36.8714	38.5101	40.1488	41.7876	43.4263	45.0650	(42c)

Average daily hot water use (litres/day) 128.6938 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	140.2155	137.1469	133.4244	127.7990	123.2181	118.2984	116.4334	120.1401	124.0456	129.2072	134.9183	139.8510	(44)
Energy conte	222.0671	195.2953	205.0684	174.9504	165.8753	145.4616	140.8161	148.7585	152.9606	175.3329	192.2158	218.9728	(45)
Energy content (annual)										Total = Sum(45)m =		2137.7749	
Distribution loss (46)m = 0.15 x (45)m	33.3101	29.2943	30.7603	26.2426	24.8813	21.8192	21.1224	22.3138	22.9441	26.2999	28.8324	32.8459	(46)

Water storage loss:

Store volume 300.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.1127 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.1409 (55)

Total storage loss

35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)

If cylinder contains dedicated solar storage

35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)
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)
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

280.6959	248.2504	263.6972	231.6880	224.5041	202.1992	199.4449	207.3873	209.6982	233.9617	248.9534	277.6016	(62)
-43.4988	-38.4707	-40.2843	-33.3570	-31.0875	-26.6018	-24.9350	-26.5158	-27.5233	-32.4469	-36.7584	-42.6933	(63a)
-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)
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)
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

237.1971	209.7796	223.4129	198.3309	193.4165	175.5974	174.5100	180.8715	182.1749	201.5148	212.1950	234.9083	(64)
								Total per year (kWh/year) = Sum(64)m =			2423.9089	(64)
12Total per year (kWh/year)											2424	(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

120.7404	107.2997	115.0883	103.5611	102.0566	93.7560	93.7244	96.3652	96.2495	105.2012	109.3018	119.7115	(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	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	176.4017	195.3019	176.4017	182.2817	176.4017	182.2817	176.4017	176.4017	182.2817	176.4017	182.2817	176.4017	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
348.6331 352.2508 343.1342 323.7262 299.2271 276.2013 260.8187 257.2010 266.3175 285.7255 310.2247 333.2504 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.8594 37.8594 37.8594 37.8594 37.8594 37.8594 37.8594 37.8594 37.8594 37.8594 37.8594 37.8594 (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)
-118.8752 -118.8752 -118.8752 -118.8752 -118.8752 -118.8752 -118.8752 -118.8752 -118.8752 -118.8752 -118.8752 -118.8752 (71)
Water heating gains (Table 5)
162.2854 159.6722 154.6886 143.8348 137.1728 130.2167 125.9737 129.5232 133.6798 141.3995 151.8081 160.9026 (72)
Total internal gains
757.8984 777.8031 744.8027 720.4209 683.3798 656.2780 630.7722 630.7040 649.8573 674.1049 714.8927 741.1329 (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	8.6770	10.6334	0.6300	0.7000	0.7700	28.1977	(74)
South	26.4600	46.7521	0.6300	0.7000	0.7700	378.0615	(78)
West	1.8200	19.6403	0.6300	0.7000	0.7700	10.9242	(80)

Solar gains 417.1834 694.4246 915.4703 1089.8213 1189.9426 1170.4458 1132.7732 1058.0016 974.9253 757.3331 496.5385 359.1704 (83)
Total gains 1175.0818 1472.2277 1660.2730 1810.2422 1873.3224 1826.7237 1763.5455 1688.7056 1624.7826 1431.4381 1211.4312 1100.3033 (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	37.0108	37.1033	37.1945	37.6289	37.7113	38.0996	38.0996	38.1724	37.9491	37.7113	37.5450	37.3727	
alpha	3.4674	3.4736	3.4796	3.5086	3.5141	3.5400	3.5400	3.5448	3.5299	3.5141	3.5030	3.4915	
util living area	0.9879	0.9736	0.9506	0.9019	0.8141	0.6682	0.5160	0.5539	0.7525	0.9196	0.9769	0.9903	(86)
MIT	18.9465	19.2733	19.6764	20.1659	20.5758	20.8544	20.9561	20.9429	20.7645	20.2179	19.4903	18.8954	(87)
Th 2	19.8598	19.8623	19.8647	19.8763	19.8785	19.8886	19.8886	19.8905	19.8847	19.8785	19.8741	19.8695	(88)
util rest of house	0.9850	0.9675	0.9389	0.8774	0.7655	0.5819	0.3987	0.4373	0.6767	0.8943	0.9705	0.9879	(89)
MIT 2	17.4812	17.8964	18.4044	19.0142	19.4941	19.7895	19.8699	19.8641	19.7071	19.0904	18.1831	17.4223	(90)
Living area fraction										fLA = Living area / (4) =		0.2610	(91)
MIT	17.8636	18.2557	18.7364	19.3148	19.7764	20.0675	20.1534	20.1456	19.9831	19.3847	18.5243	17.8068	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8636	18.2557	18.7364	19.3148	19.7764	20.0675	20.1534	20.1456	19.9831	19.3847	18.5243	17.8068	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9775	0.9555	0.9236	0.8625	0.7605	0.5969	0.4280	0.4656	0.6842	0.8803	0.9596	0.9815	(94)
Useful gains	1148.5894	1406.7667	1533.3736	1561.3721	1424.6073	1090.4406	754.8039	786.3191	1111.6949	1260.1367	1162.4915	1079.9564	(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	3063.3202	3008.8402	2749.9183	2313.5220	1790.1586	1199.5224	779.5938	820.2023	1295.8312	1947.1539	2543.4362	3043.3080	(97)
Space heating kWh	1424.5597	1076.5934	905.1092	541.5479	271.9702	0.0000	0.0000	0.0000	0.0000	511.1407	994.2802	1460.7336	(98a)
Space heating requirement - total per year (kWh/year)												7185.9349	
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	1424.5597	1076.5934	905.1092	541.5479	271.9702	0.0000	0.0000	0.0000	0.0000	511.1407	994.2802	1460.7336	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7185.9349	
Space heating per m2										(98c) / (4) =		40.5962	(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	1424.5597	1076.5934	905.1092	541.5479	271.9702	0.0000	0.0000	0.0000	0.0000	511.1407	994.2802	1460.7336	(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)	1543.4016	1166.4067	980.6167	586.7258	294.6589	0.0000	0.0000	0.0000	0.0000	553.7820	1077.2266	1582.5932	(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	237.1971	209.7796	223.4129	198.3309	193.4165	175.5974	174.5100	180.8715	182.1749	201.5148	212.1950	234.9083	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.3931	87.1963	86.8606	86.1942	84.8241	79.8000	79.8000	79.8000	79.8000	86.0556	87.0728	87.4339	(217)
Fuel for water heating, kWh/month	271.4139	240.5833	257.2085	230.0979	228.0208	220.0468	218.6842	226.6560	228.2894	234.1681	243.6983	268.6696	(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	36.6528	29.4042	26.4752	19.3969	14.9827	12.2410	13.6677	17.7658	23.0761	30.2771	34.1979	37.6715	(232)

Electricity generated by PVs (Appendix M) (negative quantity)

(233a)m	-72.2309	-98.8870	-138.0289	-150.4701	-158.2467	-146.1165	-144.0962	-137.8236	-126.4061	-110.5782	-78.2638	-62.7801 (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	-50.2931	-104.5429	-205.5939	-305.7558	-401.5176	-402.6011	-398.0571	-338.4646	-249.8682	-148.7191	-66.8671	-39.8852 (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	7785.4116 (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	2867.5368 (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)	295.8090 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-4136.0937 (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	6898.6637 (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	7785.4116	0.2100	1634.9364	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2867.5368	0.2100	602.1827	(264)
Space and water heating			2237.1192	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	295.8090	0.1443	42.6944	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1423.9280	0.1353	-192.5958	
PV Unit electricity exported	-2712.1657	0.1262	-342.2168	
Total			-534.8126	(269)
Total CO2, kg/year			1756.9302	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.9300	(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	7785.4116	1.1300	8797.5151	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2867.5368	1.1300	3240.3166	(278)
Space and water heating			12037.8317	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	295.8090	1.5338	453.7217	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1423.9280	1.4999	-2135.7827	
PV Unit electricity exported	-2712.1657	0.4632	-1256.2030	
Total			-3391.9858	(283)
Total Primary energy kWh/year			9229.6685	(286)
Target Primary Energy Rate (TPER)			52.1400	(287)

Full SAP Calculation Printout

Property Reference	House B - SAP 10	**Issued on Date**	29/11/2023
Assessment Reference	001	**Prop Type Ref**	House B (Energy Efficient)
Property			

SAP Rating	77 C	**DER**	4.58	**TER**	9.93
Environmental	95 A	**% DER < TER**			53.88
CO_2 Emissions (t/year)	0.71	**DFEE**	44.82	**TFEE**	45.83
Compliance Check	See BREL	**% DFEE < TFEE**			2.22
% DPER < TPER	7.14	**DPER**	48.42	**TPER**	52.14

Assessor Details	Mr. Sam Wallis	**Assessor ID**	BA56-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	83.6800 (1b)	x	3.0000 (2b)	=	251.0400	(1b) - (3b)
First floor	93.3300 (1c)	x	2.6000 (2c)	=	242.6580	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	177.0100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	493.6980	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Balanced mechanical ventilation with heat recovery

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

Effective ac	0.2952	0.2915	0.2877	0.2690	0.2652	0.2465	0.2465	0.2427	0.2540	0.2652	0.2727	0.2802	(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	
Front Door			1.8200	1.8000	3.2760			(26)
N (Uw = 1.10)			36.9570	1.0536	38.9425			(27)
GF			83.6800	0.1100	9.2048			(28a)
Exposed Floor			9.7000	0.1100	1.0670			(28b)
Ext Wall	217.0000	38.7770	178.2230	0.1600	28.5157			(29a)
Flat Roof	93.3300		93.3300	0.1300	12.1329			(30)
Total net area of external elements Aum(A, m2)			403.7130					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.1389			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	170.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	18.6500	0.3000	5.5950
E3 Sill	14.5950	0.0400	0.5838

E3 Sill	28.1900	0.0500	1.4095	
E5 Ground floor (normal)	83.6800	0.1600	13.3888	
E20 Exposed floor (normal)	9.6200	0.3200	3.0784	
E6 Intermediate floor within a dwelling	83.6800	0.0700	5.8576	
E8 Balcony within a dwelling, wall insulation continuous	6.5720	0.0500	0.3286	
E14 Flat roof	93.3000	0.0800	7.4640	
E16 Corner (normal)	59.0000	0.0900	5.3100	
E17 Corner (inverted – internal area greater than external area)	11.8000	-0.0900	-1.0620	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 41.9537 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 135.0926 (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	48.1022	47.4913	46.8803	43.8256	43.2146	40.1599	40.1599	39.5489	41.3818	43.2146	44.4365	45.6584	(38)
Heat transfer coeff	183.1948	182.5839	181.9729	178.9182	178.3072	175.2525	175.2525	174.6415	176.4744	178.3072	179.5291	180.7510	(39)
Average = Sum(39)m / 12 =												178.7654	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0349	1.0315	1.0280	1.0108	1.0073	0.9901	0.9901	0.9866	0.9970	1.0073	1.0142	1.0211	(40)
HLP (average)												1.0099	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9719 (42)
Hot water usage for mixer showers

130.8319	128.8658	126.0007	120.5189	116.4735	111.9621	109.3978	112.2412	115.3581	120.2020	125.8015	130.3307	(42a)

Hot water usage for baths

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

45.0650	43.4263	41.7876	40.1488	38.5101	36.8714	36.8714	38.5101	40.1488	41.7876	43.4263	45.0650	(42c)

Average daily hot water use (litres/day) 161.5909 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	175.8970	172.2921	167.7883	160.6678	154.9836	148.8335	146.2692	150.7513	155.5069	161.9895	169.2278	175.3957	(44)
Energy conte	278.5778	245.3416	257.8843	219.9461	208.6377	183.0081	176.8999	186.6616	191.7556	219.8182	241.0960	274.6273	(45)
Energy content (annual)										Total = Sum(45)m =		2684.2543	

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

41.7867	36.8012	38.6827	32.9919	31.2957	27.4512	26.5350	27.9992	28.7633	32.9727	36.1644	41.1941	(46)

Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8900 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0206 (55)
Total storage loss

31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(56)

If cylinder contains dedicated solar storage

31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386	(57)
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)
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)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

333.4788	294.9296	312.7853	273.0761	263.5387	236.1381	231.8009	241.5626	244.8856	274.7192	294.2260	329.5283	(62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
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)
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)
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)

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

333.4788	294.9296	312.7853	273.0761	263.5387	236.1381	231.8009	241.5626	244.8856	274.7192	294.2260	329.5283	(64)

Total per year (kWh/year) = Sum(64)m = 3330.6693 (64)
12Total per year (kWh/year) 3331 (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

136.5479	121.2465	129.6673	115.6361	113.2928	103.3542	102.7400	105.9858	106.2627	117.0104	122.6684	135.2344	(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	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	175.8453	194.6859	175.8453	181.7068	175.8453	181.7068	175.8453	175.8453	181.7068	175.8453	181.7068	175.8453	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	348.6331	352.2508	343.1342	323.7262	299.2271	276.2013	260.8187	257.2010	266.3175	285.7255	310.2247	333.2504	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	(71)
Water heating gains (Table 5)	183.5321	180.4263	174.2841	160.6057	152.2753	143.5475	138.0914	142.4540	147.5871	157.2720	170.3728	181.7666	(72)
Total internal gains	775.5887	794.9412	760.8418	733.6169	694.9259	669.0338	642.3336	643.0785	663.1897	686.4211	729.8825	758.4406	(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	8.6770	10.6334	0.5500	0.8500	0.7700	29.8921	(74)
South	26.4600	46.7521	0.5500	0.8500	0.7700	400.7795	(78)
West	1.8200	19.6403	0.5500	0.8500	0.7700	11.5807	(80)

Solar gains	442.2523	736.1531	970.4816	1155.3095	1261.4472	1240.7787	1200.8424	1121.5777	1033.5093	802.8418	526.3759	380.7533	(83)
Total gains	1217.8410	1531.0943	1731.3235	1888.9264	1956.3731	1909.8126	1843.1761	1764.6562	1696.6990	1489.2629	1256.2584	1139.1939	(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	45.6280	45.7806	45.9343	46.7186	46.8787	47.6958	47.6958	47.8626	47.3655	46.8787	46.5596	46.2449	
alpha	4.0419	4.0520	4.0623	4.1146	4.1252	4.1797	4.1797	4.1908	4.1577	4.1252	4.1040	4.0830	
util living area	0.9853	0.9646	0.9296	0.8552	0.7333	0.5593	0.4119	0.4459	0.6554	0.8819	0.9694	0.9885	(86)
Living	19.7604	20.0080	20.2790	20.5790	20.7843	20.8923	20.9186	20.9159	20.8590	20.5844	20.1213	19.7251	
Non living	18.5996	18.9135	19.2524	19.6244	19.8559	19.9740	19.9934	19.9950	19.9412	19.6410	19.0708	18.5635	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.0543	20.0572	20.0600	20.0744	20.0772	20.0916	20.0916	20.0945	20.0859	20.0772	20.0715	20.0658	(88)
util rest of house	0.9821	0.9573	0.9152	0.8266	0.6843	0.4893	0.3298	0.3622	0.5867	0.8522	0.9618	0.9860	(89)
MIT 2	20.0543	20.0572	20.0600	20.0744	20.0772	20.0916	20.0916	20.0945	20.0859	20.0772	20.0715	20.0658	(90)
Living area fraction										fLA = Living area / (4) =		0.2610	(91)
MIT	20.3011	20.3033	20.3054	20.3160	20.3181	20.3287	20.3287	20.3308	20.3244	20.3181	20.3138	20.3096	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3011	20.3033	20.3054	20.3160	20.3181	20.3287	20.3287	20.3308	20.3244	20.3181	20.3138	20.3096	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9830	0.9593	0.9192	0.8346	0.6978	0.5081	0.3515	0.3844	0.6055	0.8606	0.9640	0.9867	(94)
Useful gains	1197.1512	1468.8437	1591.4673	1576.4776	1365.1767	970.3707	647.9084	678.4048	1027.3759	1281.7013	1210.9887	1124.0355	(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	2931.3268	2812.3861	2512.2032	2042.5217	1536.6652	1003.9699	653.4649	686.4873	1098.4558	1732.8031	2372.2681	2911.8264	(97)
Space heating kWh	1290.2266	902.8605	685.0275	335.5517	127.5874	0.0000	0.0000	0.0000	0.0000	335.6197	836.1211	1330.1165	(98a)
Space heating requirement - total per year (kWh/year)												5843.1112	
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	1290.2266	902.8605	685.0275	335.5517	127.5874	0.0000	0.0000	0.0000	0.0000	335.6197	836.1211	1330.1165	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5843.1112	
Space heating per m2											(98c) / (4) =	33.0101	(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 %) 335.9382 (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	1290.2266	902.8605	685.0275	335.5517	127.5874	0.0000	0.0000	0.0000	0.0000	335.6197	836.1211	1330.1165	(98)
Space heating efficiency (main heating system 1)	335.9382	335.9382	335.9382	335.9382	335.9382	0.0000	0.0000	0.0000	0.0000	335.9382	335.9382	335.9382	(210)
Space heating fuel (main heating system)	384.0667	268.7579	203.9148	99.8850	37.9794	0.0000	0.0000	0.0000	0.0000	99.9052	248.8914	395.9409	(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	333.4788	294.9296	312.7853	273.0761	263.5387	236.1381	231.8009	241.5626	244.8856	274.7192	294.2260	329.5283	(64)
Efficiency of water heater												119.3400	(216)
(217)m	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	119.3400	(217)
Fuel for water heating, kWh/month	279.4359	247.1339	262.0960	228.8220	220.8302	197.8701	194.2357	202.4154	205.1999	230.1988	246.5443	276.1256	(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	61.3863	55.4457	61.3863	59.4061	61.3863	59.4061	61.3863	61.3863	59.4061	61.3863	59.4061	61.3863	(231)
Lighting	39.1953	31.4439	28.3118	20.7424	16.0220	13.0901	14.6158	18.9982	24.6768	32.3773	36.5701	40.2846	(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 1739.3413 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 119.3400

Water heating fuel used 2790.9077 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.6000, SFP = 1.2000)
mechanical ventilation fans (SFP = 1.2000) 722.7739 (230a)
Total electricity for the above, kWh/year 722.7739 (231)
Electricity for lighting (calculated in Appendix L) 316.3284 (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 5569.3512 (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	1739.3413	0.1563	271.8080	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2790.9077	0.1410	393.6145	(264)
Space and water heating			665.4225	(265)
Pumps, fans and electric keep-hot	722.7739	0.1387	100.2576	(267)
Energy for lighting	316.3284	0.1443	45.6560	(268)
Total CO2, kg/year			811.3361	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.5800	(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	1739.3413	1.5785	2745.5634	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2790.9077	1.5215	4246.3705	(278)
Space and water heating			6991.9338	(279)
Pumps, fans and electric keep-hot	722.7739	1.5128	1093.4123	(281)
Energy for lighting	316.3284	1.5338	485.1950	(282)
Total Primary energy kWh/year			8570.5411	(286)
Dwelling Primary energy Rate (DPER)			48.4200	(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	83.6800 (1b)	x	3.0000 (2b)	=	251.0400	(1b) - (3b)
First floor	93.3300 (1c)	x	2.6000 (2c)	=	242.6580	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 177.0100						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	493.6980	(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) =	0.0810	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3310	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3310	(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	0.4221	0.4138	0.4055	0.3641	0.3558	0.3145	0.3145	0.3062	0.3310	0.3558	0.3724	0.3889	(22b)
Effective ac	0.5891	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756	(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			1.8200	1.0000	1.8200			(26)
TER Opening Type (Uw = 1.20)			36.9570	1.1450	42.3206			(27)
GF			83.6800	0.1300	10.8784			(28a)
Exposed Floor			9.7000	0.1300	1.2610			(28b)
Ext Wall	217.0000	38.7770	178.2230	0.1800	32.0801			(29a)
Flat Roof	93.3300		93.3300	0.1100	10.2663			(30)
Total net area of external elements Aum(A, m2)			403.7130					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		98.6265			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 170.0000 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	18.6500	0.0500	0.9325
E3	Sill	14.5950	0.0500	0.7298
E3	Sill	28.1900	0.0500	1.4095
E5	Ground floor (normal)	83.6800	0.1600	13.3888
E20	Exposed floor (normal)	9.6200	0.3200	3.0784
E6	Intermediate floor within a dwelling	83.6800	0.0000	0.0000
E8	Balcony within a dwelling, wall insulation continuous	6.5720	0.0000	0.0000
E14	Flat roof	93.3000	0.0800	7.4640
E16	Corner (normal)	59.0000	0.0900	5.3100
E17	Corner (inverted – internal area greater than external area)	11.8000	-0.0900	-1.0620

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 31.2509 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 129.8774 (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	95.9705	95.4070	94.8547	92.2606	91.7753	89.5159	89.5159	89.0975	90.3862	91.7753	92.7571	93.7836	(38)
Heat transfer coeff	225.8479	225.2844	224.7321	222.1380	221.6527	219.3933	219.3933	218.9749	220.2636	221.6527	222.6345	223.6610	(39)

Average = Sum(39)m / 12 = 222.1357

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2759	1.2727	1.2696	1.2549	1.2522	1.2394	1.2394	1.2371	1.2444	1.2522	1.2578	1.2636	(40)
HLP (average)												1.2549	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9719 (42)

Hot water usage for mixer showers

95.1505	93.7206	91.6369	87.6501	84.7080	81.4270	79.5620	81.6300	83.8968	87.4196	91.4920	94.7859	(42a)

Hot water usage for baths

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

45.0650	43.4263	41.7876	40.1488	38.5101	36.8714	36.8714	38.5101	40.1488	41.7876	43.4263	45.0650	(42c)

Average daily hot water use (litres/day) 128.6938 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	140.2155	137.1469	133.4244	127.7990	123.2181	118.2984	116.4334	120.1401	124.0456	129.2072	134.9183	139.8510	(44)
Energy conte	222.0671	195.2953	205.0684	174.9504	165.8753	145.4616	140.8161	148.7585	152.9606	175.3329	192.2158	218.9728	(45)

Energy content (annual) Total = Sum(45)m = 2137.7749

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

33.3101	29.2943	30.7603	26.2426	24.8813	21.8192	21.1224	22.3138	22.9441	26.2999	28.8324	32.8459	(46)

Water storage loss:

Store volume 300.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.1127 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.1409 (55)

Total storage loss

35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)

If cylinder contains dedicated solar storage

35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)
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)
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)

Primary loss

Combi loss

Total heat required for water heating calculated for each month

280.6959	248.2504	263.6972	231.6880	224.5041	202.1992	199.4449	207.3873	209.6982	233.9617	248.9534	277.6016	(62)
-43.4988	-38.4707	-40.2843	-33.3570	-31.0875	-26.6018	-24.9350	-26.5158	-27.5233	-32.4469	-36.7584	-42.6933	(63a)
-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)
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)
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)

WWHRS

PV diverter

Solar input

FGHRS

Output from w/h

237.1971	209.7796	223.4129	198.3309	193.4165	175.5974	174.5100	180.8715	182.1749	201.5148	212.1950	234.9083	(64)

Total per year (kWh/year) = Sum(64)m = 2423.9089 (64)

12Total per year (kWh/year) 2424 (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

120.7404	107.2997	115.0883	103.5611	102.0566	93.7560	93.7244	96.3652	96.2495	105.2012	109.3018	119.7115	(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	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	148.5940	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	176.4017	195.3019	176.4017	182.2817	176.4017	182.2817	176.4017	176.4017	182.2817	176.4017	182.2817	176.4017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	348.6331	352.2508	343.1342	323.7262	299.2271	276.2013	260.8187	257.2010	266.3175	285.7255	310.2247	333.2504	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	37.8594	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	-118.8752	(71)
Water heating gains (Table 5)	162.2854	159.6722	154.6886	143.8348	137.1728	130.2167	125.9737	129.5232	133.6798	141.3995	151.8081	160.9026	(72)

Total internal gains

	757.8984	777.8031	744.8027	720.4209	683.3798	656.2780	630.7722	630.7040	649.8573	674.1049	714.8927	741.1329 (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	8.6770	10.6334	0.6300	0.7000	0.7700	28.1977	(74)
South	26.4600	46.7521	0.6300	0.7000	0.7700	378.0615	(78)
West	1.8200	19.6403	0.6300	0.7000	0.7700	10.9242	(80)

Solar gains	417.1834	694.4246	915.4703	1089.8213	1189.9426	1170.4458	1132.7732	1058.0016	974.9253	757.3331	496.5385	359.1704 (83)
Total gains	1175.0818	1472.2277	1660.2730	1810.2422	1873.3224	1826.7237	1763.5455	1688.7056	1624.7826	1431.4381	1211.4312	1100.3033 (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	37.0108	37.1033	37.1945	37.6289	37.7113	38.0996	38.0996	38.1724	37.9491	37.7113	37.5450	37.3727	
alpha	3.4674	3.4736	3.4796	3.5086	3.5141	3.5400	3.5400	3.5448	3.5299	3.5141	3.5030	3.4915	
util living area	0.9879	0.9736	0.9506	0.9019	0.8141	0.6682	0.5160	0.5539	0.7525	0.9196	0.9769	0.9903	(86)
MIT	18.9465	19.2733	19.6764	20.1659	20.5758	20.8544	20.9561	20.9429	20.7645	20.2179	19.4903	18.8954	(87)
Th 2	19.8598	19.8623	19.8647	19.8763	19.8785	19.8886	19.8886	19.8905	19.8847	19.8785	19.8741	19.8695	(88)
util rest of house	0.9850	0.9675	0.9389	0.8774	0.7655	0.5819	0.3987	0.4373	0.6767	0.8943	0.9705	0.9879	(89)
MIT 2	17.4812	17.8964	18.4044	19.0142	19.4941	19.7895	19.8699	19.8641	19.7071	19.0904	18.1831	17.4223	(90)
Living area fraction										fLA = Living area / (4) =		0.2610	(91)
MIT	17.8636	18.2557	18.7364	19.3148	19.7764	20.0675	20.1534	20.1456	19.9831	19.3847	18.5243	17.8068	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8636	18.2557	18.7364	19.3148	19.7764	20.0675	20.1534	20.1456	19.9831	19.3847	18.5243	17.8068	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9775	0.9555	0.9236	0.8625	0.7605	0.5969	0.4280	0.4656	0.6842	0.8803	0.9596	0.9815	(94)
Useful gains	1148.5894	1406.7667	1533.3736	1561.3721	1424.6073	1090.4406	754.8039	786.3191	1111.6949	1260.1367	1162.4915	1079.9564	(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	3063.3202	3008.8402	2749.9183	2313.5220	1790.1586	1199.5224	779.5938	820.2023	1295.8312	1947.1539	2543.4362	3043.3080	(97)
Space heating kWh	1424.5597	1076.5934	905.1092	541.5479	271.9702	0.0000	0.0000	0.0000	0.0000	511.1407	994.2802	1460.7336	(98a)
Space heating requirement - total per year (kWh/year)												7185.9349	
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	1424.5597	1076.5934	905.1092	541.5479	271.9702	0.0000	0.0000	0.0000	0.0000	511.1407	994.2802	1460.7336	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7185.9349	
Space heating per m2											(98c) / (4) =	40.5962	(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	1424.5597	1076.5934	905.1092	541.5479	271.9702	0.0000	0.0000	0.0000	0.0000	511.1407	994.2802	1460.7336	(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)	1543.4016	1166.4067	980.6167	586.7258	294.6589	0.0000	0.0000	0.0000	0.0000	553.7820	1077.2266	1582.5932	(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	237.1971	209.7796	223.4129	198.3309	193.4165	175.5974	174.5100	180.8715	182.1749	201.5148	212.1950	234.9083	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.3931	87.1963	86.8606	86.1942	84.8241	79.8000	79.8000	79.8000	79.8000	86.0556	87.0728	87.4339	(217)
Fuel for water heating, kWh/month	271.4139	240.5833	257.2085	230.0979	228.0208	220.0468	218.6842	226.6560	228.2894	234.1681	243.6983	268.6696	(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	36.6528	29.4042	26.4752	19.3969	14.9827	12.2410	13.6677	17.7658	23.0761	30.2771	34.1979	37.6715	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-72.2309	-98.8870	-138.0289	-150.4701	-158.2467	-146.1165	-144.0962	-137.8236	-126.4061	-110.5782	-78.2638	-62.7801	(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	-50.2931	-104.5429	-205.5939	-305.7558	-401.5176	-402.6011	-398.0571	-338.4646	-249.8682	-148.7191	-66.8671	-39.8852	(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	(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	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year	
Space heating fuel - main system 1	7785.4116 (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	2867.5368 (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)	295.8090 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-4136.0937 (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	6898.6637 (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	7785.4116	0.2100	1634.9364	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2867.5368	0.2100	602.1827	(264)
Space and water heating			2237.1192	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	295.8090	0.1443	42.6944	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1423.9280	0.1353	-192.5958	
PV Unit electricity exported	-2712.1657	0.1262	-342.2168	
Total			-534.8126	(269)
Total CO2, kg/year			1756.9302	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.9300	(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	7785.4116	1.1300	8797.5151	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2867.5368	1.1300	3240.3166	(278)
Space and water heating			12037.8317	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	295.8090	1.5338	453.7217	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1423.9280	1.4999	-2135.7827	
PV Unit electricity exported	-2712.1657	0.4632	-1256.2030	
Total			-3391.9858	(283)
Total Primary energy kWh/year			9229.6685	(286)
Target Primary Energy Rate (TPER)			52.1400	(287)

APPENDIX III – WATER EFFICIENCY CALCULATION

http://www.thewatercalculator.org.uk/

Congratulations

Sturt Avenue

You are within your target maximum consumption of potable water (110 litres per person per day).

Total water consumption from your calculation **107.59** litres per person per day

This calculator is intended to inform design choices by demonstrating the likely impact of specification changes on total water consumption. Results can only be used to demonstrate compliance with the Code for Sustainable Homes when the calculations have been verified by a suitably qualified Code for Sustainable Homes assessor.

Calculation summary

Installation type	Unit of measure	Capacity / flow rate	Use factor	Fixed use	Litres / person / day
WCs (single flush)	Flush volume (litres)		4.42	0	17.64
WCs (dual flush)	Average effective flushing volume (litres)	3.99			
Taps (excl. kitchen/utility room)	Flow rate (litres / minute)	6	1.58	1.58	11.06
Bath (shower also present)	Capacity to overflow (litres)	169	0.11	0	18.59
Shower (bath also present)	Flow rate (litres / minute)	8	4.37	0	34.96
Kitchen/utility room sink taps	Flow rate (litres / minute)	9	0.44	10.36	14.32
Washing machine	Litres / kg dry load	8.17	2.1	0	17.16
Dishwasher	Litres / place setting	1.25	3.6	0	4.5
Waste disposal unit	Litres / use	☐	3.08	0	
Water softener	Litres / person / day	☐	1	0	
Contribution from Grey Water					undefined
Contribution from Rain Water					undefined
				Normalisation factor	∑ × 0.91

calculator & site development by Seedypea