EAL CONSULT BUILDING SUSTAINABILITY SINCE 2008

ENERGY & SUSTAINABILITY ASSESSMENT

63 SHELDON AVENUE

PROPERTY ADDRESS

63 Sheldon Avenue
London
N6 4NH

DATE SUBMITTED

March 2026

PREPARED BY

EAL Consult

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1. EXECUTIVE SUMMARY

Site description

This Energy and Sustainability Assessment has been prepared to support the planning application for the demolition and erection of a new build house in Highgate, with a gross internal floor area of 820m^2. The site is located within Highgate Conservation Area and the development seeks to enhance the local area through its design.

Strategy

The strategy highlights how the proposed development will promote sustainability throught both design and operation and responds to the UK Planning and regulatory framework, National Planning Policy Framework 2021, the London Plan 2021 and the Haringey Local Plan Strategic Policies 2013-2026, summarising how the relevant targets will be addressed and achieved. In light of the Carbon Management feedback encouraging the consideration of solar photovoltaic panels (PV) in the scheme alongside Haringey's policy on the inclusion of PV in conservation areas being encouraged under certain conditions, a principal energy strategy is proposed which includes PV as well as an Air Source Heat Pump (ASHP) as the renewable technology. An alternative strategy is set out where an ASHP as the sole source of renewable technology. This report will demonstrate that whereas carbon offset can be addressed equally with both options, the amount of on-site carbon offset is greater where PV panels are installed.

Energy Hierarchy

In accordance with the Energy Hierarchy detailed within The London Plan 2021, this statement outlines an overall commitment to reducing energy consumption under occupancy through the adoption of a 'Fabric First' principle, which will seek to enhance insulation standards and improved heating and lighting efficiencies in comparison to the standard requirements of Approved Document Part L 2021. The viability of district heating will be explored. Further carbon emission reduction will be achieved by using renewable technologies.

- ***Be 'Lean':*** Passive design principles including a high level of insulation and reduced air permeabilty to deliver Part L compliant Building in absence of renewable technologies. It will achieve **24%** reduction in carbon emissions over Part L 2013 baseline.
- ***Be 'Clean':*** district heating was deemed not viable for this project
- ***Be 'Green':*** Air Source Heat Pumps (ASHP) and Photovoltaic panels (PV) have been proposed for the specific scheme. Air Source Heat Pumps alone will achieve a 62% reduction in regulated carbon emissions over Part L 2013 baseline, with the additional PV resulting in an overall 64% reduction.

Energy Effcicency & Carbon Reduction

- This report demonstrates that the proposed development, by incorporating the measures above, can achieve an **ove**rall carbon emission reduction of 89% with the use of ASHP and PV
- To combat the shortfall in reduction, the following carbon offset is suggested:
  - **£3,692 (ASHP and PV)**

Overheating

The development minimises adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

Sustainability

Sustainable Design:

- Natural lighting is incorporated to prevent excessive demand for artificial lighting
- The development will not increase the air pollution of the area
- Total internal water consumption will not exceed 105 litres/person/day
- All contractors should sign up to the nationally recognised Considerate Constructors Scheme
- Designated space for waste and recycling facilities
- Low Flood Risk area

Urban Greening

- Urban Greening Factor (UGF) of 0.5 proposed

Reducing Waste and Supporting the Circular Economy:

- Minimising the use of virgin materials during construction by recycling and reusing where feasible.
- Promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible
- Encourage waste minimisation and waste prevention through the reuse of materials and using fewer resources in the production and distribution of products
- Low waste benchmark levels will be targeted during construction with requirements identifying that the diversion of waste from landfill is to be achieved by the contractor.

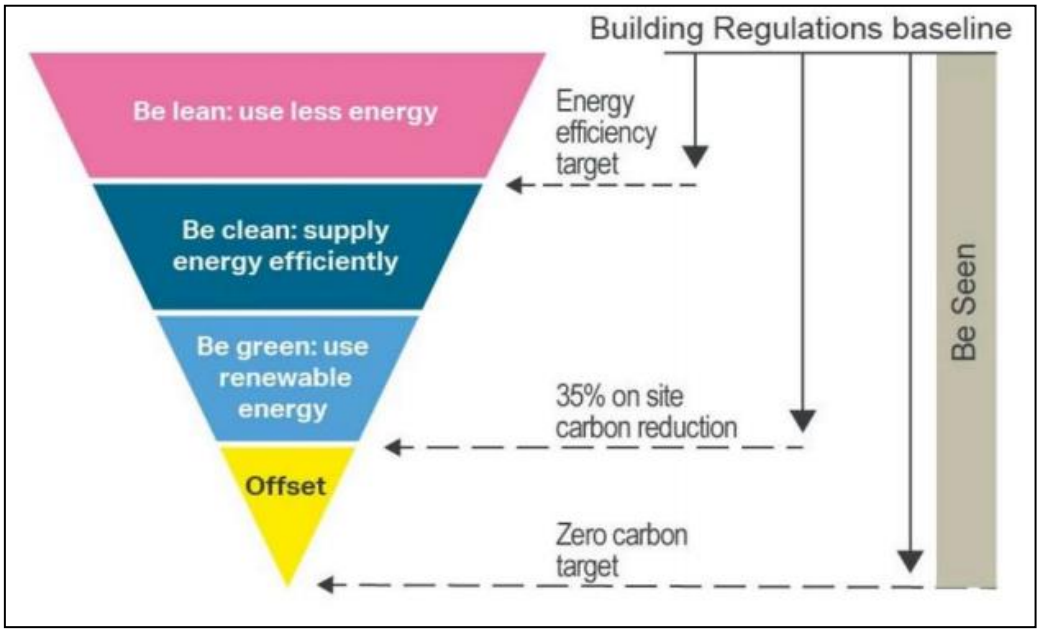
2. METHODOLOGY

This energy assessment outlines the energy demand from the development together with the associated CO_2 emissions, using Building Regulations Part L 2013 as a baseline. It demonstrates how the emissions from energy use in the development will be reduced through energy efficiency measures.

The proposed scheme is required to achieve carbon emission reduction principles in accordance with the UK Planning and regulatory framework.

The methodology employed to determine the potential CO_2 savings is in accordance with the three-step Energy Hierarchy.

Figure 1: The London Plan Energy Hierarchy



- ***Be 'Lean'*** **-** Improve the energy efficiency of the scheme;
- ***Be 'Clean'*** **-** Supply as much of the remaining energy requirement with low carbon; technologies such as district heating if available or combined heat and power (CHP); and
- ***Be 'Green'*** **-** Offset a proportion of the remaining carbon dioxide emissions by using renewable technologies.
- ***Be 'Seen'*** - monitor, verify and report on post-construction energy performance

The government approved Standard Assessment Procedure (SAP) methodology software (2021) has been used to determine the CO_2 emissions and energy requirements. It compares CO_2 emissions from regulated energy use (DER) with those of an equivalent dwelling built to Part L 2021 (TER), a notional dwelling of the same size and shape.

Opportunities for incorporating features into the development that contribute to the objectives of sustainable development were explored during the design process, to ensure that where possible, the proposals achieve best practice.

3. PLANNING POLICY CONTEXT

National Planning Policy Framework (NPPF) 2021

Emphasised the concept of sustainable development by encouraging local authorities to adopt proactive strategies to mitigate and adapt to climate change. It recommends the move to a low carbon future by:

- Avoiding increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
- Contributing to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.
- To help increase the use and supply of renewable and low carbon energy and heat, plans should:
    - provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
    - consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
    - identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for colocating potential heat customers and suppliers.

The London Plan 2021

Policy SI 2 Minimising Greenhouse Gas Emissions:

A. Development proposals should make the fullest contribution to reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy: i) Be lean: use less energy and manage demand during operation, ii) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly, iii) Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site, iiii) Be seen: monitor, verify and report on energy performance

B. Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C. A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either: i) through a cash in lieu contribution to the borough's carbon offset fund, or i) off-site provided that an alternative proposal is identified, and delivery is certain.

D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

Policy 5.3 Sustainable Design and Construction

Major development proposals should meet minimum standards outlines in the supplementary guidance Sustainable Design and Construction SPG (2014), to consider the following principles:

a. Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
b. Avoiding internal overheating and contributing to the urban heat island effect
c. Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
d. Minimising pollution (including noise, air and urban runoff)
e. Minimising the generation of waste and maximising reuse or recycling
f. Avoiding impacts from natural hazards (including flooding)
g. Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
h. Securing sustainable procurement of materials, using local supplies where feasible, and
i. Promoting and protecting biodiversity and green infrastructure.

Haringey Local Plan Strategic Policies 2013-2026

SP4: Working Towards a Low Carbon Haringey

Over the life time of the Local Plan, reducing energy use in buildings and working towards a low carbon borough will be one of the key challenges facing Haringey. The Council will promote the measures outlined below to reduce carbon emissions from new and existing buildings.

1. In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction and occupation, by incorporating the following measures:
    a. From 2011 onwards, all new residential development will achieve a minimum 25% in emissions in total (regulated) CO2 emissions in line with Code for Sustainable Homes Level 4 energy standards, and should aim to achieve Level 6. All new residential development shall be zero carbon from 2016 onwards.
    b. From 2011 onwards all new non-residential development shall be built to at least BREEAM “very good” standard and should aim to achieve BREEAM “excellent” or the current nationally agreed standard. All new non-residential development shall be zero carbon from 2019.
2. The Council will promote low- and zero-carbon energy generation through the following measures:
    a. Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;
3. d. All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on site renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.

SP5: Water Management and Flooding

The Council will require all development in Haringey to be water efficient during construction and operation and to reduce all forms of food risk. All development shall:

- Improve the water environment, water quality and drainage systems;
- Minimise water use and illustrate how development would contribute to general and flash flooding;
- Take account of flood risk vulnerability classification as set out in paragraph 100 of the NPPF and will apply the NPPF Sequential Test and Exception Test;

- Implement measures to prevent (or mitigate as last resort) local surface water and downstream flooding;
- Implement Sustainable Drainage Systems from strategic to individual site level to improve water attenuation, quality and amenity;

SP6: Waste and Recycling

The Council supports the objectives of sustainable waste management set out by the Government in PPS10 Planning for Sustainable Waste Management and the Mayor's London Plan. To achieve these, the Council shall:

- Maximise self-sufficiency in waste management capacity;
- Seek to minimise waste creation, increase recycling rates in relation to commercial, industrial and municipal waste in order to achieve the Mayor's recycling targets;
- Address waste as a resource and look to disposal as the last option, in line with the Mayor's waste hierarchy;
- Require integrated, well-designed recycling facilities to be incorporated into all new developments;
- Monitor changes in the stock of waste management facilities, waste arisings, and the amount of waste recycled, recovered and going for disposal;

Haringey will require Site Waste Management Plans for all major applications to identify volume and types of demolition and construction waste and to demonstrate how waste will be minimised and managed during construction and occupation.

Development Management DPD, adopted July 2017

Policy DM21: Sustainable Design, Layout and Construction

A. All new development, including building and landscape works, will be expected to consider and implement sustainable design, layout and construction techniques. Proposals should:
   a. Apply the energy hierarchy to minimise energy use in order to meet, and if possible exceed, minimum carbon dioxide reduction requirements;
   b. Apply the cooling hierarchy to reduce the potential for overheating and limit reliance on mechanical air conditioning systems;
   c. Maximise opportunities to enhance biodiversity on-site, including through appropriate landscaping, Sustainable Drainage Systems, living roofs and green walls
   d. Wherever possible, use building materials with high environmental performance ratings; and
   e. Seek opportunities for locally sourced labour.
B. The Council will support appropriate measures to sustainably retro t existing homes and non-residential buildings.
C. Proposals that fail to demonstrate adequate consideration for sustainable design, layout and construction techniques will be resisted.
D. Consideration will be given to the use of carbon offset payments, to be secured by planning obligations, where it can be demonstrated that proposals are unable to meet carbon dioxide emission reduction targets on-site.

Policy DM22: Decentralised Energy

A. Subject to other policy requirements, proposals that contribute to the provision and use of Decentralised Energy network infrastructure will be supported. Communal energy systems
B. All development that incorporates site-wide communal energy systems should examine opportunities for extending such systems, irrespective of whether it is connected to a DE network.

All development that incorporates site-wide communal energy systems should optimise opportunities for extending such systems beyond the site boundary to supply energy to neighbouring existing and planned future developments.

Policy DH1: Highgate Neighbourhood Plan 2017

- Proposals to demolish buildings and structures that are non-designated heritage assets should make a positive contribution to the conservation area.
- Proposals be in line with Highgate's identity as a green area

4. ENERGY STRATEGY

The Energy strategy for the proposed dwelling is based on the Building Regulations Part L; it adopts a set of principles to guide design and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. It seeks to incorporate energy efficiency through the approach detailed below.

The following tables and graph demonstrate the carbon emissions and savings.

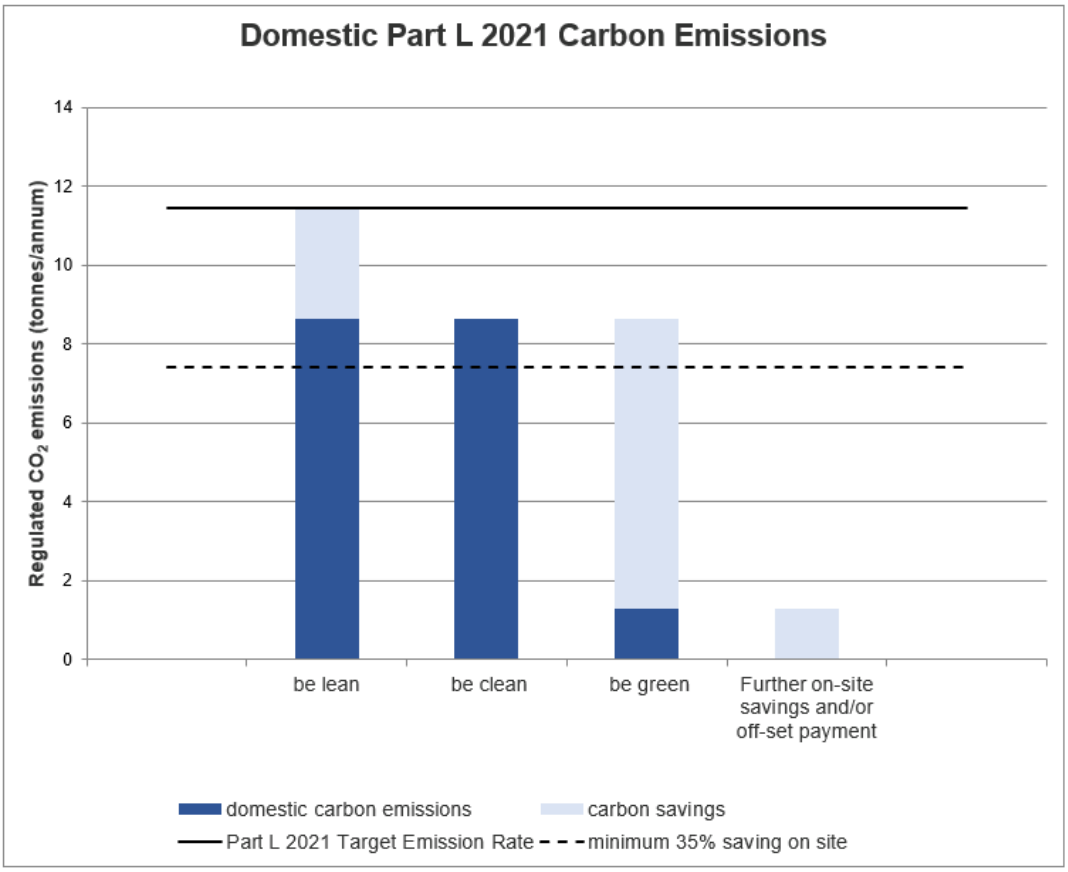
Table 1. Carbon Dioxide emissions after each stage of the Energy Hierarchy

	Regulated Carbon dioxide emissions (Tonnes CO_2 per annum)	
	ASHP Only	ASHP and PV
Baseline: Part L 2013 of the Building Regulations Compliant Development	11.4	11.4
After Energy Demand Reduction (Be Lean)	8.7	8.7
After Heat Network Connection (Be Clean)	8.7	8.7
After Renewables (Be Green)	1.5	1.3

Table 2. Carbon Dioxide Savings from each stage of the Energy Hierarchy

	Regulated Carbon dioxide savings			
	ASHP Only		ASHP and PV	
	Tonnes CO_2 per annum	%	Tonnes CO_2 per annum	%
Be Lean: Savings from Energy Demand Reduction	2.8	24%	2.8	24%
Be Clean: Savings from Heat Network	0	0%	0	0%
Be Green: Savings from Renewable Energy	7.1	62%	7.4	64%
Cumulative on-site savings	9.9	87%	10.1	89%
Carbon Shortfall	1.5		1.3	
(tonnes CO_2)				
Cumulative Savings for offset payment	45		39	
Cash-in-lieu contribution	4,312		3,692	

Figure 2: Savings in regulated CO_2 emissions from the London Plan Energy Hierarchy



a. Baseline Model

In accordance with London Plan Policy SI 2, a baseline model is run assuming the development complied with Part L 2013 of the Building Regulations. This baseline model is then used in the Energy Strategy process in comparison to the Be 'Lean', Be 'Clean' and Be 'Green' scenarios of the Energy Hierarchy, to establish the regulated CO^2 emissions from the development.

The baseline model used for this project assumed that any heating and hot water supply would be provided by gas boilers and any active cooling would be provided by electrically powered equipment. The comparative Be 'Lean' model assumes the same heating strategy.

The assumed U-values of the baseline model are seen in the table below:

Table 3. Part L Building Regulations U-values

Thermal element	2013 Baseline Model	Be 'Lean' Scenario
Wall	0.28 W/m^2k	0.14 W/m^2k
Roof	0.16 W/m^2k	0.11 W/m^2k
Floor	0.22 W/m^2k	0.10 W/m^2k
Glazing	1.8 W/m^2k	1.1 W/m^2k

b. Be 'Lean' - Demand Reduction

In accordance with London Plan Policy SI 2 the development must achieve at least a 10% improvement in energy efficiency on Building Regulations Part L 2013 baseline scenario.

The building fabric performance and engineering systems have been optimised in order to use less energy prior to the inclusion or consideration of Low and Zero Carbon (LZC) Technology.

Through passive design measures, efficient building fabric and engineering systems the building is estimated to achieve **24%** reduction in annual regulated CO_2 emissions over Part L benchmark, therefore demonstrating compliance with Building Regulations Through passive means alone without the utilisation of renewable technologies.

Passive Design Measures

Fabric Performance - The fabric performance values aim to reduce unwanted heat loss and heat gains, whilst maintaining a comfortable internal environment.

The heat loss of different building elements is dependent upon their U –value. A building with low U values provides better levels of insulation and reduced heating demand.

The development will incorporate high levels of insulation and efficient glazing; thereby reduce demand for space heating. The table below shows the U values for the development and the associated improvements over Building Regulations.

Table 4. Development Part L Fabric Energy Efficiency Standard (FEES)

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)
Development Total	44.22	38.12

Thermal Bridging - Thermal bridging will be reduced. The thermal bridging calculations achieve a y-value of 0.035 aligning with enhanced construction detail and cold bridges will be avoided. See Appendix 5.

Thermal Mass - The assumed thermal mass is 113.76 kJ/m2K.

Efficient Lighting and Controls - Throughout the development natural lighting will be optimised. The development will also incorporate low energy light fittings throughout. All light fittings will be specified as low energy lighting and will accommodate LED luminaries only.

Ventilation - The use of natural ventilation is proposed for the dwelling.

Space Heating & Cooling - Space heating will be provided by underfloor heating by the ASHP

Domestic Hot Water (DHW) system – domestic hot water is supplied for the dwelling via hot water cylinder.

c. Be 'Clean' - Supply Energy Efficiently

The Be Clean step of the energy hierarchy refers to the use of 'Clean energy supply'. This includes, but is not limited to, the use of Combined Heat and Power (CHP) and District Heat Networks. Policy SI 3 seeks for new development to promote the use of CHP and district heating.

Policy SI 1 Improving Air Quality

A. Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.
B. To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:
    1. Development proposals should not:
        a. lead to further deterioration of existing poor air quality
        b. create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits
        c. create unacceptable risk of high levels of exposure to poor air quality.
    2. In order to meet the requirements in Part 1, as a minimum:
        a. development proposals must be at least Air Quality Neutral
        b. development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures
        c. development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.
E. Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.

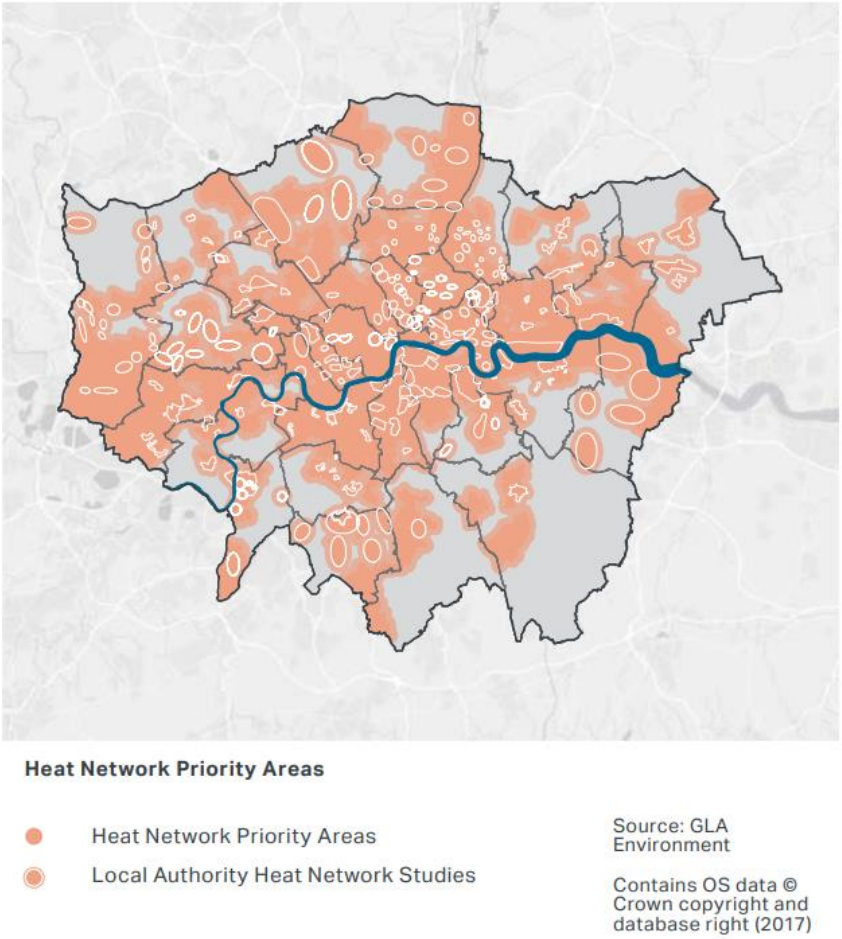
Policy SI 3 Energy Infrastructure

A. Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

C. Development Plans should:

1. identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
2. identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

Figure 3: Heat Network Priority Areas



District Heating and Cooling

There is no existing or planned heat and energy network in the vicinity and the site does not fall into an opportunity area with decentralised energy potential as identified in the London Plan.

Community heating and Combined Heat and Power (CHP system)

CHP systems are usually needed where there is a large heat demand (schemes with more than 100-150 dwellings), usually resulting from the building(s) being in continuous use, or through specific heating requirements such as a swimming pool. Community (or district) heating involves using a central boiler plant (or other heat sources) to heat a number of buildings through a network of well-insulated underground pipes. This system is not considered appropriate for this development

In light of the small scale of the proposed development, it is apparent that the use of CHP is also technically and financially unviable in this instance.

Site-wide communal system/network and design for district network connection

In light of the small scale of the proposed development and it is location; it is apparent that the use a heatpump fed site-wide network is technically and financially unviable.

Air Quality

In line with London Plan Policy SI 1 all developments are required to demonstrate compliance with the Building Emission Benchmarks (BEB) set out in the Air Quality Neutral LPG. The BEB demonstrates the emissions from equipment used to supply heat and energy to the buildings.

As the heating system proposed for this development is a heat pump, in accordance with the Air Quality Neutral LPG it is assumed that this project meets BEB and a full Air Quality Neutral (AQN) Assessment is not required.

d. Be 'Green' - Renewable Energy

In accordance with London Plan Policy SI 2 and Local Plan Policy SP4 all new development must achieve a minimum 20% reduction from on-site renewable energy generation.

Once energy demand reduction measures have been applied, methods for generating low and zero carbon energy can be assessed. The following renewable technologies can be considered for the project: Biomass, Water source heat pump, air source heat pump, Wind energy and solar photovoltaic panels.

Table 5. Renewable Technologies Feasibility Table

Technology	Pros	Cons
Biomass Heating A biomass system designed for wood pellets, which have a high-energy content, would fuel this development. 	• Less volume of storage • Less maintenance and produce considerably less ash residue	• Nox Emissions which may impacts • High Costs • Not suitable for the project

Ground Source Heat Pump It circulates a mixture of water and antifreeze around a loop of pipe, called a ground loop, which is buried in the garden. Heat from the ground is absorbed into the fluid and passes through a heat exchanger into the heat pump 	• Use all through the year	• High Costs • Not suitable for this project
Air Source Heat Pump They are an efficient and environmentally-friendly way of heating using air drawn freely from the atmosphere. They operate rather like a refrigerator in reverse, absorbing heat from the air into a working fluid which is passed into a compressor where its temperature is increased before it is transferred into the heating and hot water circuits of the building	• Can generate less CO_2 than conventional heating systems. • Cheaper • Provides heating and hot water • Less maintenance • Can be used as air-conditioning in the summer	• Needs electricity • Can be noisy
Wind Turbines Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings. 	• Cheaper • Less CO_2	• Local wind speeds in the area is likely to be below the level generally required for investment in large wind turbines. • Noise and signal interference. • Detrimental aesthetic impact
Solar Photovoltaic Panels (PV) Photovoltaic panels extract the energy of the sun to generate electricity. They operate most efficiently when oriented to the south and are inclined to about 35 degrees. 	• Cheaper • Less CO_2 • No input power in order to generate electricity. • In keeping with the character and appearance of the historic environment	

Renewable Technologies Feasibility Review Conclusion

The renewable energy sources that have been reviewed for this project are Biomass Heating, Ground Source Heat Pump, Air Source Heat Pump, Domestic Wind Turbine and Solar Photovoltaic Panels (PV).

Haringey's Local Plan policy states that the installation of micro-generation technologies such as solar panels in conservation areas will be accommodated where possible, in ways which don't harm the historic environment. Historic fabric should not be disturbed or destroyed. Where possible, equipment should be installed in discreet locations where it will not affect the character and appearance of the historic environment.

For this scheme, the PV will be applied in a way that is complimentary and non-obtrusive to the character and appearance of the historic environment.

The use of ASHP alone as the renewable technology contribution results in a CO_2 percentage reduction of **62%** contributing to an overall reduction of **87%** in carbon emissions. On review of the above, it has been concluded that the use of an Air Source Heat Pump (ASHP) together with solar photovoltaic panels (PV) in the design is preferable because together they achieve an overall CO_2 percentage reduction of **64%** contributes to an overall reduction of **89%** in carbon emissions.

The location of the ASHP and PV can be found in Appendix 6, 7 and 8.

Table 6. Photovoltaic Panels

System size	Degree	Orientation
3 kWp	30	South facing

Table 7. ASHP Specification

Seasonal Coefficient of Performance (SCOP)		Seasonal Energy Efficiency Ratio (SEER)	
35°c	50°c	7°c	18°c
4.49	3.59	4.69	6.75

e. Be 'Seen' - Monitoring Performance

In accordance with London Plan Policy Guidance 'Be Seen' Energy Monitoring 1.2, the following is suggested:

1.2.1 To truly achieve net zero-carbon buildings we need to have a better understanding of their actual operational energy performance. Although Part L calculations and Energy Performance Certificates (EPCs) give an indication of the theoretical performance of buildings, it is well established that there is a 'performance gap' between design theory and measured reality.

1.2.2 To address this gap the London Plan Policy SI 2 'Minimising greenhouse gas emissions' introduces a fourth stage to the energy hierarchy; the 'be seen' stage, which requires monitoring and reporting of the actual operational energy performance of major developments for at least five years via the Mayor's 'be seen' monitoring portal.

1.2.3 The 'be seen' policy establishes post-construction monitoring as good practice, enabling developers and building owners to better understand their buildings and identify methods for improving energy performance from the project inception stage and throughout the building's lifetime.

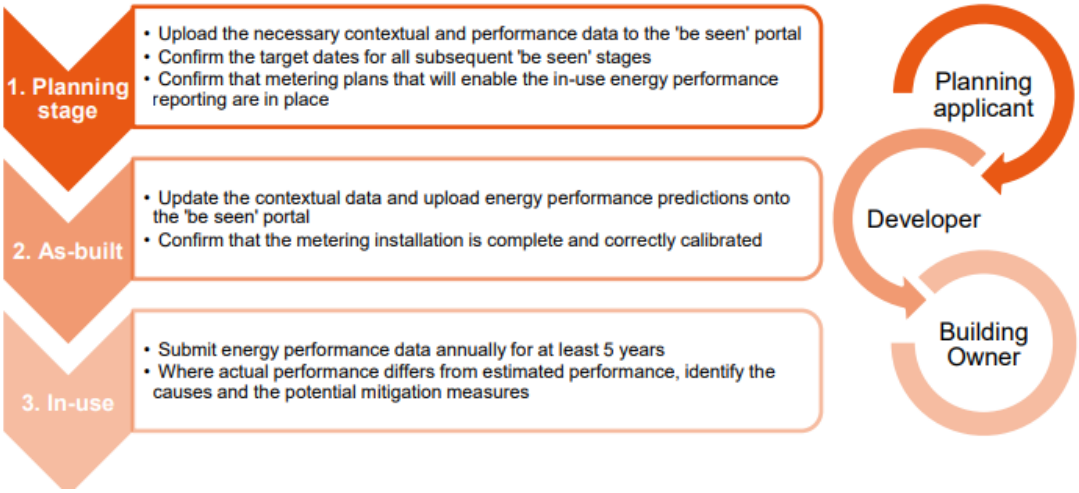
1.2.4 Ensuring that the actual energy and carbon performance of buildings is aligned with the estimated energy and carbon performance will also be a key factor in achieving a zero-carbon London.

1.2.5 The energy performance data that will be collected will provide an evidence base which could help inform future industry-wide benchmarks or performance ratings for major building typologies based on in-use performance

1.2.6 An effectively implemented post-construction monitoring regime can have a number of benefits including environmental (for example, carbon emissions reduction) and socio-economic (for example, reduced occupants' bills, raised awareness around energy usage).

Figure 4 outlines the 'be seen' process through the reporting stages of a development

Figure 4 'Be seen' process and responsibilities



Smart metering equipment will be installed with display of energy usage and generation to raise awareness of occupants. This can help occupants to reduce demand and subsequent running costs. The GLA spreadsheet informs the planning stage energy performance data including carbon offset. An on-site operational manual will be provided for the occupants on completion of the build to assist residents better understanding of appliances and cost management.

5. SUSTAINABILITY STRATEGY

a. Sustainable Design

London Plan Policy 5.3 Sustainable Design and Construction and Sustainable Design and Construction SPG (2014) to consider the following principles:

a. Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
b. Avoiding internal overheating and contributing to the urban heat island effect
c. Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
d. Minimising pollution (including noise, air and urban runoff)
e. Minimising the generation of waste and maximising reuse or recycling
f. Avoiding impacts from natural hazards (including flooding)
g. Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
h. Securing sustainable procurement of materials, using local supplies where feasible, and
i. Promoting and protecting biodiversity and green infrastructure.

The proposed project incorporates sustainable design and construction measures capable of mitigating and adapting to climate change to meet future needs. This section details site-specific initiatives which demonstrate how the conversion helps to meet the sustainability objectives set out in the National Planning Framework 2021.

Materials Efficiency

Materials can have a significant impact on environmental performance, both in construction but also ongoing use. Materials used for the building will have lower environmental impacts over their lifecycle. This applies to the materials used in the external walls, roof and glazing. This extends to elements of the materials category such as the basic building materials (internal walls) and the finishing elements (fascia, skirting, and furniture).

b. Overheating Strategy

Policy SI 4 Managing Heat Risk

A. Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

The Good Homes Alliance (GHA) Early Stage Overheating Risk Tool has been completed as part of the preliminary energy information for the development and can be found in Appendix 9. The development achieves an overall score of 1 on the tool, demonstrating a low overheating risk.

Minimise Heat Generation Through Energy Efficient Design

Through the use of passive and active design measures, the design team have enabled the development to require less energy through the use of optimised insulation, cross ventilation, improved window u-values, higher air tightness, reduced cold bridging and light coloured materials.

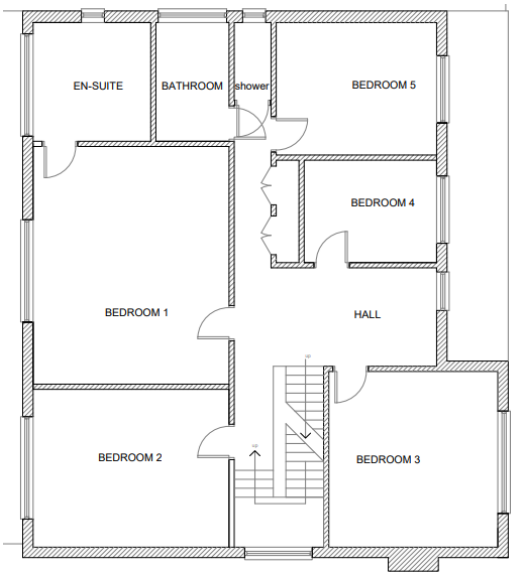
Table 8. Thermal Elements Performance

Element	
Orientation	East front facing
Solar Shading	North and South shading from neighboring properties. East and West partial shading from trees
Ventilation	Natural
Glazing Percentage	≈25%
Air Permeability	3.00

Daylight

The design of the development has taken into consideration day lighting to habitable spaces to improve the wellbeing of occupants. Good levels of daylight will offer occupants a pleasant and highly valued connection to the outdoors and plenty of natural light. It will also reduce the use of artificial lighting and therefore energy use. All light fittings will be specified as low energy lighting.
No external lighting is required. The location and orientation of windows help to create a design that avoids overheating in the summer.

Figure 5. Internal layout



c. Water Efficiency

Water: Water Efficiency

In domestic and non-domestic buildings, the demand for water can be reduced as much as 50% using a variety of simple and innovative strategies that are integrated into the plumbing and mechanical systems. In order to reduce water consumption the proposed development will include efficient fixtures with low flow rates. Total internal water consumption will not exceed 105 litres/person/day.

Table 9. Water Fittings Standards

Schedule Appliance Water Consumption		
Appliance	**Flow rate or Capacity**	**Total Litres**
WC	Dual flush WC 4/2.6 litre	14.72
Basin	1.7 litres/min	5.98
Shower	8 litres/minute flow	24.00
Bath	160 litres	25.60
Sink	4 litres/min	14.13
W/machine	Default used	16.66
Dish Washer	Default used	3.90
		104.99

d. Pollution: Light, Air and Noise

Light

Light pollution can best be described as artificial light that is allowed to illuminate or intrude upon areas not intended to be lit. Light in the wrong place at the wrong time can be intrusive.
Intrusive light is over bright or poorly directed lights shining onto neighbouring property which affect the neighbours' right to enjoy their property. Therefore, the proposal will incorporate lighting measures in order to avoid causing a nuisance.

Air and Noise

The layout of the development can provide good internal air quality for habitable areas but not too much so as to waste heat.

The use of openable windows will create horizontal airflow. By achieving a good naturally ventilated building the energy demand for air conditioning and mechanical ventilation will thereby be eliminated within the development.

The development will not increase the air pollution of the area by reducing as a start, its energy use, which in turn will reduce emissions that lead to air pollution.
Other measures will include:

a. Use of eco-friendly building materials
b. Non-toxic paints
c. Installation of energy efficient appliances and devices
d. Use of renewable technologies

e. Waste Management

Considerate Construction

All contractors would be required to sign up to the nationally recognised Considerate Constructors Scheme which requires, amongst other things that dust emissions, potential noise pollution, impacts on water quality and the potential for ground contamination are minimised during demolition and construction. The Contractor would also be obliged to adhere to a site-specific Code of Construction Practice to reduce potential nuisance effects.

Diversion of waste from landfill

- Where possible, segregation of recyclable and non-recyclable material will be employed for all waste generated throughout the construction process. Furthermore, material will be re-used on-site where feasible;
- Pre-fabrication of materials/elements such as bathroom pods, pipework and riser materials will be considered;
- Reusable packing solutions with key product manufacturers will be explored at the earliest opportunity. Solutions may include flat pallets, bulk bags, steel stillages and returnable cable drums;
- Construction waste – minimum 80% diversion from landfill rate;
- Demolition waste – minimum 90% diversion from landfill rate;

Operational Waste

Target diversion from landfill rate to be set.

A space for reuse and recycling is included for the residents exclusive use on the outside of the southern elevation, see Appendix 6.

f. Flood Risk

Flood Risk

The development site is located in a Low Flood Risk Area on the Environment Agency Flood Risk Map.

Rainwater is to be collected and stored in a tank under the garden. Surface water runoff is reduced by this initial collection and storage, then further is absorbed by the significant vegetation and permeable paving, see Appendix 10).

g. Future Proofing

It is important to ensure developments are adaptable to changing conditions. Developments must ensure not to create any adverse local climate impacts through encouraging excessive consumption of CO2 emissions. This can be promoted through encouraging sustainable living practices and consumption.

Sustainable Travel

Sustainable travel is promoted through encouraging cycling through the provision of safe and accessible bike storage at the southern, exterior façade of the dwelling. In addition, provision is made to allow Electric Vehicle (EV) charging through a charging point at the front of the property (see Appendix 6 and 10).

Extreme Heat

The dwelling has been designed to ensure natural cooling and ventilation in periods of heat. As discussed in the Overheating Strategy in part b, the dwelling achieves a very low score on the GHA overheating risk tool. The design allows for natural ventilation and solar shading. North and South facades experience full shading from neighbouring buildings. The trees at the front of the property provide partial shade to the eastern facing façade, with numerous trees in the rear garden providing partial shade to the southern facing façade and garden. The surroundings of the development are very green, featuring a large garden and backing onto a golf course. These green surroundings assist in reducing local temperatures and aid in protecting the home from rising temperatures.

Extreme Rainfall

The development includes drainage systems to allow for sufficient rainwater drainage. This will be collected and stored in the rear garden. This system not only assists in reducing surface water run off and risk of flooding, but also allows for a more circular water usage, reducing consumption and strain on local resources.

A green roof has been included in the design and this will help to both reduce surface water run off and flood risk, but also aid in protecting the dwelling from extreme temperatures as the vegetation act as natural cooling.

h. Sustainable Procurement

It is expected that all timber used in the development will come from a legal Source (FSC Scheme). At least 80% of the building materials will be responsibly sourced and will use suppliers who can provide an EMS certificate or equivalent. Materials rated with an A or B in the BRE Green Guide to Specification will be preferred.

Other measures will be implemented:

- The reuse of existing materials from the demolition of existing buildings
- At least 20% of the total value of materials used should derive from recycled and reused content in the products and materials selected;
- Steel will have a high recycled content;
- Concrete will have a Ground Granulated Blast Furnace Slag (GGBS) value of 50%.

i. Biodiversity and Green Infrastructure

In accordance with London Plan Policy 5.3 Sustainable Design and Construction, the highest standards should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime. This section investigates how the development proposal considers sustainable design principles set out in the Sustainable Design and Construction SPG (2014).

Biodiversity

The proposed development will incorporate measures to support and enhance the environment through consideration of the existing site, including measures to mitigate the impact of the development and enhance site biodiversity.

In accordance with the London Plan and Haringey's Biodiversity Action Plan, the development will incorporate a wildflower meadow and perennial rich flower planting to encourage pollinators and feed wildlife, alongside inclusion of insect hotels which will further diversity the local wildlife. The extensive vegetation of trees and hedges allow for nesting habitats, but bird and bat boxes will also be implemented.

The growing medium for extensive roofs must be 120-150mm deep, and at least 250mm deep for intensive roofs (these are often roof-level amenity spaces) to ensure most plant species can establish and thrive and can withstand periods of drought. Living walls should be rooted in the ground with sufficient substrate depth. Living roofs are supported in principle, subject to detailed design. Details for living roofs will need to be submitted as part of a planning condition.

j. Urban Greening

Urban Greening Factor

The present scheme has an UGF of 0. 5. The table below summarise the measures to be implemented within the development. The location of PV will not affect the roof space designated to urban greening. The landscape plan can be found in Appendix 10.

Table 10. Urban Greening Factor Calculator

Urban Greening Factor Calculator				
Surface Cover Type	**Factor**	**Area (m²)**	**Contribution**	**Notes**
Semi-natural vegetation (e.g. trees, woodland, species-rich grassland) maintained or established on site.	1	320	320	
Wetland or open water (semi-natural; not chlorinated) maintained or established on site.	1	0	0	
Intensive green roof or vegetation over structure. Substrate minimum settled depth of 150mm.	0.8	40	32	
Standard trees planted in connected tree pits with a minimum soil volume equivalent to at least two thirds of the projected canopy area of the mature tree.	0.8	24	19.2	
Extensive green roof with substrate of minimum settled depth of 80mm (or 60mm beneath vegetation blanket) – meets the requirements of GRO Code 2014.	0.7	40	28	
Flower-rich perennial planting.	0.7	60	42	
Rain gardens and other vegetated sustainable drainage elements.	0.7	0	0	
Hedges (line of mature shrubs one or two shrubs wide).	0.6	32	19.2	
Standard trees planted in pits with soil volumes less than two thirds of the projected canopy area of the mature tree.	0.6	0	0	
Green wall –modular system or climbers rooted in soil.	0.6	0	0	
Groundcover planting.	0.5	0	0	
Amenity grassland (species-poor, regularly mown lawn).	0.4	70	28	
Extensive green roof of sedum mat or other lightweight systems that do not meet GRO Code 2014.	0.3	0	0	
Water features (chlorinated) or unplanted detention basins.	0.2	0	0	
Permeable paving.	0.1	70	7	
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone).	0	47	0	
Total contribution			**495.4**	
Total site area (m²)			970	
Urban Greening Factor			**0.51**	

6. CONCLUSION

The development has been designed to exceed Part L building regulations requirements. In line with the national and local policies, regulated CO_2 emissions from the development will be reduced by **89%** from the notional emissions once energy efficiency measures and lean measures are taken into account, through the use of an ASHP and PV panels. Whilst the project is within a conservation area, the PV will be applied in a way that is complimentary and non-obtrusive to the character and appearance of the historic environment.

In order to achieve the required carbon emissions reduction, the report concludes and proposes the use of energy efficient measures outlined in the section 4 of this report.

With a shortfall of 11% from achieving net-zero, a carbon offset payment of £3,692 is recommended.

An appraisal of the proposed development has been undertaken against key sustainability objectives identified from relevant policy guidance. The framework for the appraisal was guided by the National Plan. This process has ensured that the development responds to the sustainable development objectives that are relevant to the area. Key sustainability initiatives in ecology, waste management, water, health and wellbeing, materials, pollution and surface water management have been incorporated in the design of the proposed development.

7. APPENDIX

1. Baseline SAP Calculations
2. Be Lean SAP Calculations
3. Be Green SAP Calculations (ASHP)
4. Be Green SAP Calculations (ASHP and PV)
5. Thermal Bridging Calculations
6. Ground Floor Plan
7. Basement Plan
8. Roof Plan
9. GHA Overheating Risk Tool
10. Landscape Plan

EAL CONSULT
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17 Dobree Avenue
LONDON
NW10 2AD
0208 930 5668

APPENDIX 1

Project Information

Building type Detached house

Reference
Date 15 September 2022
Email: NONE Project 63 Sheldon Avenue
LONDON
N6 4NH

SAP 2012 worksheet for New dwelling as designed - calculation of energy ratings

1. Overall dwelling dimensions

	Area (m²)	Av. Storey height (m)	Volume (m³)	
Ground floor (1)	322.88	2.93	946.04	(3a)
First floor	235.08	3.37	792.22	(3b)
Second floor	195.92	3.38	662.21	(3c)
Third floor	81.96	3.37	276.21	(3d)
	835.84			**(4)**
			2676.67	**(5)**

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2. Ventilation rate

	main + seondary + other heating		m³ per hour	
Number of chimneys	0 + 0 + 0	x 40	0.00	(6a)
Number of open flues	0 + 0 + 0	x 20	0.00	(6b)
Number of intermittent fans	10	x 10	100.00	(7a)
Number of passive vents	0	x 10	0.00	(7b)
Number of flueless gas fires	0	x 40	0.00	(7c)

		Air changes per hour	
		0.04	**(8)**
Pressure test, result q50	3.00		(17)
Air permeability		0.19	(18)
		2.00	**(19)**
		0.85	**(20)**
Infiltration rate incorporating shelter factor		0.16	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70		
												52.50	(22)

Wind Factor

1.27	1.25	1.23	1.10	1.07	0.95	0.95	0.93	1.00	1.07	1.13	1.18		
												13.13	(22a)

Adjusted infiltration rate (allowing for shelter and wind speed)

0.20	0.20	0.20	0.18	0.17	0.15	0.15	0.15	0.16	0.17	0.18	0.19		
												2.09	(22b)

Ventilation : natural ventilation, intermittent extract fans

Effective air change rate

0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.51	0.51	0.52	0.52	(25)

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3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²	U-value W/m²K	A x U W/K	kappa-value kJ/m²K	A x K kJ/K	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) REAR			**16.440**	**1.05 (1.10)**	17.32			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) FRONT			**47.530**	**1.05 (1.10)**	50.08			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) SIDE			**5.950**	**1.05 (1.10)**	6.27			(27)
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) SIDE			**2.380**	**1.05 (1.10)**	2.51			(27)
Solid door FRONT			**3.520**	**1.10**	3.87			(26)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) SIDE			**1.820**	**1.10**	2.00			(26)
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) REAR			**29.120**	**1.10**	32.03			(26)
Walls EXTERNAL #WINDOWS & DOORS			376.30	0.14	52.68	70.00	26341.00	(29)
Ground floors UNDERGROUND			4.17	0.10	0.42	110.00	458.70	(28)
Flat roofs FF			35.35	0.11	3.89	9.00	318.15	(30)
Flat roofs GF			39.16	0.11	4.31	9.00	352.44	(30)
Flat roofs LGF REAR #ROOFLIGHTS			87.80	0.11	9.66	9.00	790.20	(30)
Flat roofs SF			67.71	0.11	7.45	9.00	609.39	(30)
Pitched roofs with integrated insulation ROOF VOID ABOVE FF TO SF			78.61	0.10 (Ru=0.90)	7.87	9.00	707.49	(30)
Pitched roofs insulated between rafters PART OF MAIN ROOF @ SF			113.38	0.11	12.47	9.00	1020.42	(30)
Basement walls UNDERGROUND			217.29	0.14	30.42	70.00	15210.30	
Basement floors UNDERGROUND			322.88	0.10	32.29	110.00	35516.80	
Internal floor SF			81.96	0.00	0.00	18.00	1475.28	
Internal floor GF			235.08	0.00	0.00	18.00	4231.44	

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4. Water heating energy requirements **kWh/year**

Assumed occupancy, N	3.83	(42)
Annual average hot water usage in litres per day Vd,average	125.13	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month												
137.64	132.64	127.63	122.62	117.62	112.61	112.61	117.62	122.62	127.63	132.64	137.64	(44)
Energy content of hot water used												
204.12	178.52	184.22	160.61	154.11	132.98	123.23	141.40	143.09	166.76	182.03	197.68	
Energy content (annual)											1968.74	(45)
Distribution loss												
30.62	26.78	27.63	24.09	23.12	19.95	18.48	21.21	21.46	25.01	27.30	29.65	(46)

Cylinder volume, l	300.00	(47)
Manufacturer's declared cylinder loss factor (kWh/day)	2.13	(48)
Temperature Factor	0.5400	(49)
Energy lost from hot water cylinder (kWh/day)	1.15	(55)

Total storage loss												
35.66	32.21	35.66	34.51	35.66	34.51	35.66	35.66	34.51	35.66	34.51	35.66	(56)
Net storage loss												
35.66	32.21	35.66	34.51	35.66	34.51	35.66	35.66	34.51	35.66	34.51	35.66	(57)
Primary loss												
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Total heat required for water heating calculated for each month												
263.03	231.74	243.14	217.62	213.02	190.00	182.15	200.32	200.11	225.68	239.05	256.59	(62)
Output from water heater for each month, kWh/month												
263.03	231.74	243.14	217.62	213.02	190.00	182.15	200.32	200.11	225.68	239.05	256.59	(64)
											2662.46	(64)
Heat gains from water heating, kWh/month												
115.00	101.93	108.39	99.02	98.37	89.83	88.11	94.15	93.19	102.58	106.14	112.86	(65)

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5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains, Watts												
229.71	229.71	229.71	229.71	229.71	229.71	229.71	229.71	229.71	229.71	229.71	229.71	(66)
Lighting gains												
216.44	192.24	156.34	118.36	88.48	74.69	80.71	104.91	140.81	178.79	208.68	222.46	(67)
Appliances gains												
1218.79	1231.44	1199.57	1131.72	1046.07	965.58	911.80	899.15	931.03	998.87	1084.52	1165.02	(68)
Cooking gains												
61.80	61.80	61.80	61.80	61.80	61.80	61.80	61.80	61.80	61.80	61.80	61.80	(69)
Pumps and fans gains												
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (negative values)												
-153.14	-153.14	-153.14	-153.14	-153.14	-153.14	-153.14	-153.14	-153.14	-153.14	-153.14	-153.14	(71)
Water heating gains												
154.57	151.68	145.68	137.52	132.22	124.76	118.42	126.55	129.43	137.88	147.42	151.70	(72)
Total internal gains												
1731.18	1716.74	1642.96	1528.97	1408.14	1306.41	1252.31	1271.98	1342.64	1456.92	1581.98	1680.54	(73)

6. Solar gains (calculation for January)

	Area & Flux	g & FF	Shading	Gains	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) REAR	0.9 x 16.440 11.28	0.63 x 0.70	0.77	56.6886	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthEast) FRONT	0.9 x 47.530 36.79	0.63 x 0.70	0.77	534.4593	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) SIDE	0.9 x 5.950 36.79	0.63 x 0.70	0.77	66.9058	
Window - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthEast) SIDE	0.9 x 2.380 11.28	0.63 x 0.70	0.77	8.2067	
Solid door FRONT	0.9 x 3.520 0.00	0.00 x 0.70	0.77	0.0000	
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (SouthWest) SIDE	0.9 x 1.820 36.79	0.63 x 0.70	0.77	20.4653	
Full glazed door - Double-glazed, argon filled, low-E, En=0.1, soft coat (NorthWest) REAR	0.9 x 29.120 11.28	0.63 x 0.70	0.77	100.4120	
Total solar gains, January				787.14	(83-1)

Solar gains												
787.14	1395.70	2055.5	2791.3	3349.6	3423.6	3259.8	2828.3	2308.0	1581.86	952.81	667.16	(83)
Total gains												
2518.3	3112.4	3698.5	4320.3	4757.8	4730.0	4512.2	4100.3	3650.6	3038.8	2534.8	2347.7	(84)

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7. Mean internal temperature

Temperature during heating periods in the living area, Th1 (°C) 21.00 (85)

Heating system responsiveness 0.75

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	27.75	27.77	27.79	27.88	27.90	27.98	27.98	28.00	27.95	27.90	27.86	27.83	
alpha	2.85	2.85	2.85	2.86	2.86	2.87	2.87	2.87	2.86	2.86	2.86	2.86	
Utilisation factor for gains for living area	1.00	0.99	0.98	0.96	0.91	0.82	0.71	0.76	0.91	0.98	0.99	1.00	(86)
Mean internal temperature in living area T1	18.92	19.09	19.40	19.82	20.24	20.59	20.76	20.72	20.43	19.88	19.32	18.88	(87)
Temperature during heating periods in rest of dwelling Th2	19.97	19.97	19.97	19.97	19.97	19.98	19.98	19.98	19.98	19.97	19.97	19.97	(88)
Utilisation factor for gains for rest of dwelling	0.99	0.99	0.98	0.95	0.89	0.77	0.60	0.67	0.87	0.97	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2	17.13	17.38	17.83	18.44	19.05	19.52	19.74	19.70	19.32	18.54	17.72	17.08	(90)

Living area fraction (38.51 / 835.84) 0.05 (91)

Mean internal temperature (for the whole dwelling)	17.21	17.46	17.90	18.51	19.11	19.57	19.78	19.75	19.37	18.60	17.80	17.16	(92)
Apply adjustment to the mean internal temperature, where appropriate	17.21	17.46	17.90	18.51	19.11	19.57	19.78	19.75	19.37	18.60	17.80	17.16	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains	0.99	0.98	0.97	0.93	0.86	0.74	0.58	0.64	0.84	0.95	0.99	0.99	(94)
Useful gains	2496.5	3062.6	3583.5	4035.1	4108.7	3493.9	2611.6	2618.3	3078.5	2901.6	2498.5	2330.9	(95)
Monthly average external temperature	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature	12302.1	11957.9	10849.8	9109.4	7016.6	4696.6	3008.0	3158.8	4985.3	7584.1	10147.9	12316.4	(97)
Fraction of month for heating	1.00	1.00	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	
Space heating requirement for each month, kWh/month	7295.4	5977.7	5406.1	3653.5	2163.5	-	-	-	-	3483.8	5507.5	7429.2	

Total space heating requirement per year (kWh/year) (October to May) 40916.67 (98)

Space heating requirement per m² (kWh/m²/year) 48.95 (99)

8c. Space cooling requirement - not applicable

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9a. Energy requirements

kWh/year

No secondary heating system selected

Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main heating system	93.90%	(206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement												
7295.4	5977.7	5406.1	3653.5	2163.5	-	-	-	-	3483.8	5507.5	7429.2	(98)
Appendix Q - monthly energy saved (main heating system 1)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(210)
Space heating fuel (main heating system 1)												
7769.3	6366.0	5757.3	3890.8	2304.0	-	-	-	-	3710.1	5865.3	7911.8	(211)
Appendix Q - monthly energy saved (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(212)
Space heating fuel (main heating system 2)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(213)
Appendix Q - monthly energy saved (secondary heating system)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(214)
Space heating fuel (secondary)												
0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	(215)
Water heating												
Water heating requirement												
263.03	231.74	243.14	217.62	213.02	190.00	182.15	200.32	200.11	225.68	239.05	256.59	(64)
Efficiency of water heater											80.20	(216)
90.48	90.45	90.38	90.22	89.83	80.20	80.20	80.20	80.20	90.17	90.40	90.50	(217)
Water heating fuel												
290.71	256.21	269.01	241.21	237.15	236.91	227.11	249.78	249.51	250.29	264.44	283.54	(219)

Annual totals	kWh/year	
Space heating fuel used, main system 1	43574.73	(211)
Space heating fuel (secondary)	0.00	(215)
Water heating fuel	3055.87	(219)
Electricity for pumps, fans and electric keep-hot		
central heating pump	30.00	(230c)
boiler with a fan-assisted flue	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (100.00% fixed LEL)	1528.97	(232)
Energy saving/generation technologies		
Appendix Q -		
Energy saved or generated ():	0.000	(236a)
Energy used ():	0.000	(237a)
Total delivered energy for all uses	48234.57	(238)

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10a. Fuel costs using Table 12 prices

	kWh/year	Fuel price p/kWh	£/year	
Space heating - main system 1	43574.726	3.480	1516.40	(240)
Space heating - main system 2	0.000	0.000	0.00	(241)
Water heating cost	3055.87	3.480	106.34	(247)
Mech vent fans cost	0.000	13.190	0.00	(249)
Pump/fan energy cost	75.000	13.190	9.89	(249)
Energy for lighting	1528.969	13.190	201.67	(250)
Additional standing charges			120.00	(251)
Electricity generated - PVs	0.000	0.000	0.00	(252)
Appendix Q -				
Energy saved or generated ():	0.000	0.000	0.00	(253)
Energy used ():	0.000	0.000	0.00	(254)
Total energy cost			1954.31	(255)

11a. SAP rating

	0.42	**(256)**
	0.93	**(257)**
SAP value	87.00	
	87	(258)
SAP band	**B**	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating, main system 1	43574.73	0.216	9412.14	(261)
Space heating, main system 2	0.00	0.000	0.00	(262)
Space heating, secondary	0.00	0.519	0.00	(263)
Water heating	3055.87	0.216	660.07	(264)
Space and water heating			10072.21	(265)
Electricity for pumps and fans	75.00	0.519	38.93	(267)
Electricity for lighting	1528.97	0.519	793.53	(268)
Electricity generated - PVs	0.00	0.519	0.00	(269)
Electricity generated - µCHP	0.00	0.000	0.00	(269)
Appendix Q -				
Energy saved ():	0.00	0.000	0.00	(270)
Energy used ():	0.00	0.000	0.00	(271)
Total CO2, kg/year			10904.67	(272)

	kg/m²/year	
CO2 emissions per m²	**13.05**	(273)
EI value	83.41	(273a)
EI rating	**83**	(274)
EI band	**B**	

Calculation of stars for heating and DHW

Main heating energy efficiency	(3.48 / 0.9090) x (1 + (0.29 x 0.25)) = 4.1059, stars = 4
Main heating environmental impact	(0.2160 / 0.9090) x (1 + (0.29 x 0.25)) = 0.2549, stars = 4
Water heating energy efficiency	3.48 / 0.8694 = 4.0030, stars = 4
Water heating environmental impact	0.2160 / 0.8694 = 0.2485, stars = 4

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APPENDIX 2

Full SAP Calculation Printout

elmhurst energy

Property Reference	Proposed 63	Issued on Date	15/05/2023
Assessment Reference	Boiler	Prop Type Ref	63 SHELDON
Property	63, Sheldon Avenue, LONDON, N6 4NH		

SAP Rating	89 B	DER	10.35	TER	7.73
Environmental	87 B	% DER < TER			-33.89
CO_2 Emissions (t/year)	7.77	DFEE	38.12	TFEE	44.22
Compliance Check	See BREL	% DFEE < TFEE			13.80
% DPER < TPER	-35.32	DPER	56.51	TPER	41.76

Assessor Details	Mr. Mark Simons	Assessor ID	5542-0001
Client	EALConsult, Mark Simons		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	322.8800	(1a) x	2.9300	(2a) =	946.0384	(1a) -
Ground floor	235.0800	(1b) x	3.3700	(2b) =	792.2196	(1b) -
First floor	195.9200	(1c) x	3.3800	(2c) =	662.2096	(1c) -
Second floor	81.9600	(1d) x	3.3700	(2d) =	276.2052	(1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 835.8400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	2676.6728	(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	10 * 10 =	100.0000	(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) =	100.0000 / (5) =	0.0374	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1874	(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) =	0.1874	(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	0.2389	0.2342	0.2295	0.2061	0.2014	0.1780	0.1780	0.1733	0.1874	0.2014	0.2108	0.2201	(22b)
Effective ac	0.5285	0.5274	0.5263	0.5212	0.5203	0.5158	0.5158	0.5150	0.5176	0.5203	0.5222	0.5242	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			103.2400	1.0536	108.7778			(27)
Entrance Door			3.5200	1.1000	3.8720			(26)
Rooflights			9.8400	1.0536	10.3678			(27a)
GF			4.1700	0.1000	0.4170	110.0000	458.7000	(28a)
BASEMENT			322.8800	0.1000	32.2880	110.0000	35516.8000	(28a)

EXTERNAL	483.0600	106.7600	376.3000	0.1400	52.6820	70.0000	26341.0000 (29a)
BASEMENT	217.2900		217.2900	0.1400	30.4206	70.0000	15210.3000 (29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885	9.0000	318.1500 (30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076	9.0000	352.4400 (30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	9.0000	701.6400 (30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481	9.0000	609.3900 (30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1043	8.1963	9.0000	707.4900 (30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718	9.0000	1020.4200 (30)
Total net area of external elements Aum(A, m2)			1449.4100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	283.7131		(33)
Internal Floor GF			235.0800			18.0000	4231.4400 (32d)
Internal Floor FF			195.9200			18.0000	3526.5600 (32d)
Internal Floor SF			81.9600			18.0000	1475.2800 (32d)
Internal Ceiling LGF			235.0800			9.0000	2115.7200 (32e)
Internal Ceiling GF			195.9200			9.0000	1763.2800 (32e)
Internal Ceiling FF			81.9600			9.0000	737.6400 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 95086.2500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.3000	11.5590
E3 Sill	37.6400	0.0400	1.5056
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0700	6.2020
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0400	0.4832
E14 Flat roof	56.1400	0.0400	2.2456
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 47.3556 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 331.0687 (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	466.8540	465.8754	464.9161	460.4103	459.5673	455.6430	455.6430	454.9163	457.1546	459.5673	461.2727	463.0556	(38)
Heat transfer coeff	797.9227	796.9441	795.9848	791.4790	790.6360	786.7117	786.7117	785.9850	788.2233	790.6360	792.3414	794.1243	(39)
Average = Sum(39)m / 12 =												791.4750	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9546	0.9535	0.9523	0.9469	0.9459	0.9412	0.9412	0.9404	0.9430	0.9459	0.9480	0.9501	(40)
HLP (average)												0.9469	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	88.4118	87.0832	85.1471	81.4426	78.7089	75.6602	73.9274	75.8488	77.9551	81.2284	85.0124	88.0731	(42a)
Hot water usage for baths	40.1507	39.5544	38.7147	37.1665	36.0071	34.7216	34.0273	34.8611	35.7690	37.1445	38.7247	40.0150	(42b)
Hot water usage for other uses	56.6715	54.6107	52.5499	50.4891	48.4283	46.3676	46.3676	48.4283	50.4891	52.5499	54.6107	56.6715	(42c)
Average daily hot water use (litres/day)												170.2583	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	185.2340	181.2483	176.4117	169.0982	163.1444	156.7494	154.3222	159.1383	164.2132	170.9229	178.3478	184.7595	(44)
Energy conte	293.3654	258.0952	271.1382	231.4870	219.6237	192.7417	186.6393	197.0464	202.4913	231.9407	254.0891	289.2888	(45)
Energy content (annual)										Total = Sum(45)m =		2827.9468	
Distribution loss (46)m = 0.15 x (45)m	44.0048	38.7143	40.6707	34.7231	32.9436	28.9113	27.9959	29.5570	30.3737	34.7911	38.1134	43.3933	(46)

Water storage loss:
Store volume 300.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 0.7368 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.8125 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	56.1888	50.7512	56.1888	54.3763	56.1888	54.3763	56.1888	56.1888	54.3763	56.1888	54.3763	56.1888	(56)
If cylinder contains dedicated solar storage	56.1888	50.7512	56.1888	54.3763	56.1888	54.3763	56.1888	56.1888	54.3763	56.1888	54.3763	56.1888	(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	372.8167	329.8576	350.5894	308.3753	299.0749	269.6300	266.0906	276.4977	279.3796	311.3920	330.9774	368.7400	(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
372.8167 329.8576 350.5894 308.3753 299.0749 269.6300 266.0906 276.4977 279.3796 311.3920 330.9774 368.7400 (64)
Total per year (kWh/year) = Sum(64)m = 3763.4212 (64)
12Total per year (kWh/year) 3763 (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
161.1050 143.2266 153.7144 138.4801 136.5859 125.5973 125.6186 129.0789 128.8390 140.6813 145.9953 159.7495 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	417.1479	461.8423	417.1479	431.0528	417.1479	431.0528	417.1479	417.1479	431.0528	417.1479	431.0528	417.1479	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	216.5390	213.1348	206.6054	192.3334	183.5832	174.4406	168.8422	173.4932	178.9431	189.0878	202.7712	214.7171	(72)
Total internal gains													
	1533.7068	1583.4707	1510.8936	1465.0677	1385.0289	1332.8588	1277.3252	1273.5026	1314.2108	1358.9093	1443.8813	1495.8548	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3800	11.2829	0.6300	1.0000	0.7700	11.7239	(75)
Southeast	47.5300	36.7938	0.6300	1.0000	0.7700	763.5133	(77)
Southwest	7.7700	36.7938	0.6300	1.0000	0.7700	124.8159	(79)
Northwest	45.5600	11.2829	0.6300	1.0000	0.7700	224.4294	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	1226.0255	2204.7471	3311.3531	4573.4281	5535.0650	5671.9172	5395.0592	4653.5975	3746.2081	2517.5693	1490.0371	1035.0948	(83)
Total gains	2759.7323	3788.2178	4822.2467	6038.4959	6920.0939	7004.7760	6672.3844	5927.1001	5060.4188	3876.4787	2933.9184	2530.9496	(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	33.1020	33.1427	33.1826	33.3715	33.4071	33.5737	33.5737	33.6048	33.5093	33.4071	33.3352	33.2603	
alpha	3.2068	3.2095	3.2122	3.2248	3.2271	3.2382	3.2382	3.2403	3.2340	3.2271	3.2223	3.2174	
util living area													
	0.9949	0.9859	0.9638	0.9026	0.7860	0.6267	0.4870	0.5553	0.7906	0.9513	0.9896	0.9961	(86)
MIT	18.9970	19.2639	19.6606	20.1589	20.5588	20.7882	20.8666	20.8464	20.6446	20.0848	19.4393	18.9510	(87)
Th 2	20.1213	20.1223	20.1233	20.1278	20.1286	20.1326	20.1326	20.1333	20.1311	20.1286	20.1269	20.1251	(88)
util rest of house													
	0.9940	0.9835	0.9575	0.8854	0.7488	0.5632	0.4019	0.4681	0.7394	0.9395	0.9875	0.9955	(89)
MIT 2	17.7127	18.0543	18.5590	19.1844	19.6626	19.9161	19.9881	19.9744	19.7740	19.1035	18.2832	17.6564	(90)
Living area fraction									fLA = Living area / (4) =			0.0461	(91)
MIT	17.7719	18.1100	18.6098	19.2293	19.7039	19.9563	20.0286	20.0145	19.8141	19.1487	18.3365	17.7160	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7719	18.1100	18.6098	19.2293	19.7039	19.9563	20.0286	20.0145	19.8141	19.1487	18.3365	17.7160	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9905	0.9756	0.9429	0.8637	0.7282	0.5493	0.3911	0.4552	0.7176	0.9216	0.9811	0.9927	(94)
Useful gains	2733.4448	3695.7575	4546.8664	5215.5534	5039.5097	3847.5312	2609.8534	2698.1457	3631.2234	3572.6063	2878.4089	2512.3832	(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													
	10749.5462	10527.6349	9639.1783	8175.4500	6328.1326	4213.8543	2697.2839	2840.9723	4504.0090	6758.8999	8903.1232	10733.4164	(97)
Space heating kWh													
	5963.9795	4591.0216	3788.6801	2131.1255	958.7354	0.0000	0.0000	0.0000	0.0000	2370.6024	4337.7943	6116.4487	(98a)
Space heating requirement - total per year (kWh/year)												30258.3876	
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													
	5963.9795	4591.0216	3788.6801	2131.1255	958.7354	0.0000	0.0000	0.0000	0.0000	2370.6024	4337.7943	6116.4487	(98c)

Space heating requirement after solar contribution - total per year (kWh/year)		30258.3876
Space heating per m2	(98c) / (4) =	36.2012 (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 %)	84.2000 (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													
	5963.9795	4591.0216	3788.6801	2131.1255	958.7354	0.0000	0.0000	0.0000	0.0000	2370.6024	4337.7943	6116.4487	(98)
Space heating efficiency (main heating system 1)													
	84.2000	84.2000	84.2000	84.2000	84.2000	0.0000	0.0000	0.0000	0.0000	84.2000	84.2000	84.2000	(210)
Space heating fuel (main heating system)													
	7083.1110	5452.5198	4499.6200	2531.0279	1138.6407	0.0000	0.0000	0.0000	0.0000	2815.4423	5151.7747	7264.1909	(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													
	372.8167	329.8576	350.5894	308.3753	299.0749	269.6300	266.0906	276.4977	279.3796	311.3920	330.9774	368.7400	(64)
Efficiency of water heater												80.2000	(216)
(217)m	83.6149	83.5340	83.3602	82.9523	81.8817	75.2000	75.2000	75.2000	75.2000	83.0527	83.4960	83.6345	(217)
Fuel for water heating, kWh/month													
	445.8733	394.8781	420.5720	371.7500	365.2523	358.5505	353.8438	367.6831	371.5154	374.9328	396.3992	440.8949	(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	99.0824	79.4876	71.5698	52.4351	40.5024	33.0908	36.9476	48.0259	62.3809	81.8471	92.4461	101.8362	(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	35936.3273 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.2000
Water heating fuel used	4662.1454 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	799.6518 (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	41484.1245 (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	35936.3273	0.2100	7546.6287	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4662.1454	0.2100	979.0505	(264)
Space and water heating			8525.6793	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	799.6518	0.1443	115.4145	(268)
Total CO2, kg/year			8653.0230	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.3500	(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	35936.3273	1.1300	40608.0498	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4662.1454	1.1300	5268.2243	(278)
Space and water heating			45876.2741	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	799.6518	1.5338	1226.5327	(282)
Total Primary energy kWh/year			47232.9076	(286)
Dwelling Primary energy Rate (DPER)			56.5100	(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)	
Basement floor	322.8800 (1a)	x	2.9300 (2a)	=	946.0384 (1a)	-
Ground floor	235.0800 (1b)	x	3.3700 (2b)	=	792.2196 (1b)	-
First floor	195.9200 (1c)	x	3.3800 (2c)	=	662.2096 (1c)	-
Second floor	81.9600 (1d)	x	3.3700 (2d)	=	276.2052 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 835.8400					(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2676.6728 (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) =	0.0149	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2649	(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) =	0.2649	(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	0.3378	0.3312	0.3246	0.2914	0.2848	0.2517	0.2517	0.2451	0.2649	0.2848	0.2981	0.3113	(22b)
Effective ac	0.5571	0.5548	0.5527	0.5425	0.5406	0.5317	0.5317	0.5300	0.5351	0.5406	0.5444	0.5485	(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			3.5200	1.0000	3.5200			(26)
TER Opening Type (Uw = 1.20)			103.2400	1.1450	118.2137			(27)
Rooflights			9.8400	2.0221	19.8971			(27a)
GF			4.1700	0.1300	0.5421			(28a)
BASEMENT			322.8800	0.1300	41.9744			(28a)
EXTERNAL	483.0600	106.7600	376.3000	0.1800	67.7340			(29a)
BASEMENT	217.2900		217.2900	0.1800	39.1122			(29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885			(30)

Flat Roof GF	39.1600		39.1600	0.1100	4.3076	(30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	(30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481	(30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1100	8.6471	(30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718	(30)
Total net area of external elements Aum(A, m2)			1449.4100			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	336.3322	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.0500	1.9265
E3 Sill	37.6400	0.0500	1.8820
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0000	0.0000
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0800	0.9664
E14 Flat roof	56.1400	0.0800	4.4912
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 34.6263 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 370.9585 (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	492.0483	490.0914	488.1731	479.1632	477.4775	469.6302	469.6302	468.1769	472.6528	477.4775	480.8877	484.4529	(38)
Heat transfer coeff													
	863.0068	861.0499	859.1316	850.1217	848.4360	840.5887	840.5887	839.1354	843.6113	848.4360	851.8462	855.4114	(39)

Average = Sum(39)m / 12 = 850.1136

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0325	1.0302	1.0279	1.0171	1.0151	1.0057	1.0057	1.0039	1.0093	1.0151	1.0191	1.0234	(40)
HLP (average)												1.0171	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers													
	88.4118	87.0832	85.1471	81.4426	78.7089	75.6602	73.9274	75.8488	77.9551	81.2284	85.0124	88.0731	(42a)
Hot water usage for baths													
	38.1432	37.5767	36.7790	35.3081	34.2068	32.9855	32.3259	33.1180	33.9805	35.2873	36.7884	38.0142	(42b)
Hot water usage for other uses													
	53.8379	51.8802	49.9224	47.9647	46.0069	44.0492	44.0492	46.0069	47.9647	49.9224	51.8802	53.8379	(42c)

Average daily hot water use (litres/day) 165.8210 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	180.3929	176.5400	171.8485	164.7155	158.9226	152.6950	150.3024	154.9738	159.9003	166.4381	173.6810	179.9252	(44)
Energy conte	285.6983	251.3907	264.1247	225.4872	213.9404	187.7563	181.7778	191.8899	197.1731	225.8550	247.4404	281.7194	(45)

Energy content (annual) Total = Sum(45)m = 2754.2531

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

	42.8547	37.7086	39.6187	33.8231	32.0911	28.1634	27.2667	28.7835	29.5760	33.8782	37.1161	42.2579	(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													
	344.3271	304.3457	322.7535	282.2248	272.5692	244.4938	240.4066	250.5187	253.9106	284.4838	304.1780	340.3482	(62)
WWHRS	-40.4182	-35.7462	-37.4313	-30.9946	-28.8859	-24.7179	-23.1690	-24.6380	-25.5740	-30.1490	-34.1551	-39.6697	(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													
	303.9089	268.5995	285.3221	251.2301	243.6833	219.7760	217.2375	225.8808	228.3366	254.3348	270.0229	300.6785	(64)

Total per year (kWh/year) = Sum(64)m = 3069.0111 (64)

12Total per year (kWh/year) 3069 (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													
	141.8977	125.9514	134.7245	120.3645	118.0382	107.8190	107.3442	110.7064	110.9501	121.9998	127.6640	140.5748	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	443.4680	490.9824	443.4680	458.2502	443.4680	458.2502	443.4680	443.4680	458.2502	443.4680	458.2502	443.4680	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	190.7228	187.4277	181.0813	167.1730	158.6535	149.7486	144.2798	148.7990	154.0974	163.9783	177.3111	188.9446	(72)
Total internal gains													
	1534.2107	1586.9038	1511.6896	1467.1047	1386.4194	1335.3643	1279.0830	1275.1285	1316.5625	1360.1200	1445.6187	1496.4023	(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	2.3800	11.2829	0.6300	0.7000	0.7700	8.2067	(75)
Southeast	47.5300	36.7938	0.6300	0.7000	0.7700	534.4593	(77)
Southwest	7.7700	36.7938	0.6300	0.7000	0.7700	87.3711	(79)
Northwest	45.5600	11.2829	0.6300	0.7000	0.7700	157.1006	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	888.6807	1606.5920	2430.4254	3377.1470	4099.5020	4204.6718	3997.9831	3441.4671	2757.0852	1839.6273	1081.6904	749.1710	(83)
Total gains	2422.8914	3193.4958	3942.1150	4844.2517	5485.9214	5540.0361	5277.0660	4716.5956	4073.6477	3199.7473	2527.3090	2245.5733	(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	30.6056	30.6752	30.7437	31.0695	31.1312	31.4218	31.4218	31.4763	31.3093	31.1312	31.0066	30.8774	
alpha	3.0404	3.0450	3.0496	3.0713	3.0754	3.0948	3.0948	3.0984	3.0873	3.0754	3.0671	3.0585	
util living area													
	0.9963	0.9912	0.9793	0.9451	0.8710	0.7446	0.6099	0.6758	0.8701	0.9714	0.9931	0.9971	(86)
MIT	18.1909	18.4935	18.9842	19.6567	20.2672	20.7036	20.8865	20.8410	20.4629	19.6541	18.8057	18.1510	(87)
Th 2	20.0563	20.0583	20.0602	20.0691	20.0708	20.0786	20.0786	20.0800	20.0756	20.0708	20.0674	20.0639	(88)
util rest of house													
	0.9957	0.9896	0.9754	0.9337	0.8420	0.6821	0.5105	0.5808	0.8290	0.9637	0.9916	0.9966	(89)
MIT 2	16.6960	17.0842	17.7118	18.5677	19.3205	19.8281	20.0088	19.9744	19.5718	18.5745	17.4903	16.6491	(90)
Living area fraction									fLA = Living area / (4) =			0.0461	(91)
MIT	16.7648	17.1492	17.7704	18.6179	19.3641	19.8685	20.0492	20.0143	19.6129	18.6242	17.5509	16.7183	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.7648	17.1492	17.7704	18.6179	19.3641	19.8685	20.0492	20.0143	19.6129	18.6242	17.5509	16.7183	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9815	0.9607	0.9094	0.8146	0.6658	0.5070	0.5732	0.8029	0.9455	0.9849	0.9933	(94)
Useful gains	2402.6463	3134.4556	3787.1993	4405.4208	4468.6858	3688.3950	2675.3861	2703.3218	3270.5765	3025.3898	2489.0290	2230.6101	(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													
	10757.2410	10547.1325	9682.7758	8261.4059	6502.4775	4428.6125	2899.3909	3032.8844	4650.7386	6808.0456	8902.5699	10708.2830	(97)
Space heating kWh													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(98a)
Space heating requirement - total per year (kWh/year)												33612.3305	
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													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												33612.3305	
Space heating per m2											(98c) / (4) =	40.2138	(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													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(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)													
	6734.3645	5396.8785	4752.2307	3007.9190	1639.3728	0.0000	0.0000	0.0000	0.0000	3049.0747	5002.9788	6833.5738	(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													
	303.9089	268.5995	285.3221	251.2301	243.6833	219.7760	217.2375	225.8808	228.3366	254.3348	270.0229	300.6785	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.3356	88.2905	88.1925	87.9766	87.4322	79.8000	79.8000	79.8000	79.8000	87.9776	88.2501	88.3466	(217)
Fuel for water heating, kWh/month													
	344.0390	304.2223	323.5220	285.5646	278.7110	275.4085	272.2275	283.0586	286.1361	289.0904	305.9744	340.3396	(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	92.1439	73.9212	66.5579	48.7632	37.6661	30.7735	34.3602	44.6628	58.0125	76.1155	85.9723	94.7048	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-236.8929	-305.5310	-401.6282	-410.9453	-410.5931	-370.9295	-365.0299	-358.9818	-346.0060	-327.0440	-249.4235	-208.1750	(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	-235.8670	-479.4048	-924.2432	-1349.4061	-1749.2625	-1746.3020	-1726.8735	-1478.7804	-1105.8513	-673.4567	-310.5655	-187.9600	(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	36416.3928	(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	3588.2938	(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)	743.6540	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-15959.1530	(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	24875.1876	(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	36416.3928	0.2100	7647.4425	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3588.2938	0.2100	753.5417	(264)
Space and water heating			8400.9842	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	743.6540	0.1443	107.3322	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3991.1800	0.1367	-545.4331	
PV Unit electricity exported	-11967.9730	0.1267	-1516.7747	
Total			-2062.2078	(269)
Total CO2, kg/year			6458.0379	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.7300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	36416.3928	1.1300	41150.5238	(275)
Total CO2 associated with community systems			0.0000	(473)

Water heating (other fuel)	3588.2938	1.1300	4054.7720	(278)
Space and water heating			45205.2959	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	743.6540	1.5338	1140.6413	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3991.1800	1.5052	-6007.4585	
PV Unit electricity exported	-11967.9730	0.4652	-5568.0282	
Total			-11575.4867	(283)
Total Primary energy kWh/year			34900.5512	(286)
Target Primary Energy Rate (TPER)			41.7600	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	322.8800 (1a)	x	2.9300 (2a)	=	946.0384 (1a)	-
Ground floor	235.0800 (1b)	x	3.3700 (2b)	=	792.2196 (1b)	-
First floor	195.9200 (1c)	x	3.3800 (2c)	=	662.2096 (1c)	-
Second floor	81.9600 (1d)	x	3.3700 (2d)	=	276.2052 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 835.8400					(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2676.6728 (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) =	0.0149	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1649	(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) =	0.1649	(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	0.2103	0.2062	0.2021	0.1814	0.1773	0.1567	0.1567	0.1526	0.1649	0.1773	0.1856	0.1938	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5221	0.5213	0.5204	0.5165	0.5157	0.5123	0.5123	0.5116	0.5136	0.5157	0.5172	0.5188	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			103.2400	1.0536	108.7778			(27)
Entrance Door			3.5200	1.1000	3.8720			(26)
Rooflights			9.8400	1.0536	10.3678			(27a)
GF			4.1700	0.1000	0.4170	110.0000	458.7000	(28a)
BASEMENT			322.8800	0.1000	32.2880	110.0000	35516.8000	(28a)
EXTERNAL	483.0600	106.7600	376.3000	0.1400	52.6820	70.0000	26341.0000	(29a)
BASEMENT	217.2900		217.2900	0.1400	30.4206	70.0000	15210.3000	(29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885	9.0000	318.1500	(30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076	9.0000	352.4400	(30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	9.0000	701.6400	(30)

Flat Roof SF	67.7100	67.7100	0.1100	7.4481	9.0000	609.3900 (30)
Pitched Roof FF TO SF	78.6100	78.6100	0.1043	8.1963	9.0000	707.4900 (30)
Pitched Roof	113.3800	113.3800	0.1100	12.4718	9.0000	1020.4200 (30)
Total net area of external elements Aum(A, m2)		1449.4100				(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		283.7131		(33)
Internal Floor GF		235.0800			18.0000	4231.4400 (32d)
Internal Floor FF		195.9200			18.0000	3526.5600 (32d)
Internal Floor SF		81.9600			18.0000	1475.2800 (32d)
Internal Ceiling LGF		235.0800			9.0000	2115.7200 (32e)
Internal Ceiling GF		195.9200			9.0000	1763.2800 (32e)
Internal Ceiling FF		81.9600			9.0000	737.6400 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 95086.2500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.3000	11.5590
E3 Sill	37.6400	0.0400	1.5056
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0700	6.2020
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0400	0.4832
E14 Flat roof	56.1400	0.0400	2.2456
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 47.3556 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 331.0687 (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	461.1842	460.4257	459.6822	456.1901	455.5367	452.4953	452.4953	451.9320	453.6668	455.5367	456.8585	458.2403	(38)
Heat transfer coeff	792.2529	791.4944	790.7509	787.2588	786.6054	783.5639	783.5639	783.0007	784.7355	786.6054	787.9272	789.3090	(39)
Average = Sum(39)m / 12 =												787.2557	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9479	0.9469	0.9461	0.9419	0.9411	0.9375	0.9375	0.9368	0.9389	0.9411	0.9427	0.9443	(40)
HLP (average)												0.9419	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	38.1432	37.5767	36.7790	35.3081	34.2068	32.9855	32.3259	33.1180	33.9805	35.2873	36.7884	38.0142	(42b)
Hot water usage for other uses	53.8379	51.8802	49.9224	47.9647	46.0069	44.0492	44.0492	46.0069	47.9647	49.9224	51.8802	53.8379	(42c)
Average daily hot water use (litres/day)												84.3083	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.9811	89.4569	86.7014	83.2728	80.2137	77.0347	76.3751	79.1250	81.9452	85.2097	88.6686	91.8521	(44)
Energy conte	145.6756	127.3854	133.2568	113.9963	107.9831	94.7232	92.3690	97.9732	101.0466	115.6288	126.3247	143.8182	(45)
Energy content (annual)										Total = Sum(45)m =		1400.1809	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
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	123.8242	108.2776	113.2683	96.8969	91.7856	80.5147	78.5137	83.2772	85.8896	98.2844	107.3760	122.2455	(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	123.8242	108.2776	113.2683	96.8969	91.7856	80.5147	78.5137	83.2772	85.8896	98.2844	107.3760	122.2455	(64)
									Total per year (kWh/year) = Sum(64)m =			1190.1537	(64)
12Total per year (kWh/year)												1190	(64)
Electric shower(s)	70.8031	63.0862	68.8877	65.7387	66.9722	63.8850	66.0145	66.9722	65.7387	68.8877	67.5923	70.8031	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						805.3816	(64a)
Heat gains from water heating, kWh/month	48.6568	42.8409	45.5390	40.6589	39.6895	36.0999	36.1321	37.5624	37.9071	41.7930	43.7421	48.2622	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	417.1479	461.8423	417.1479	431.0528	417.1479	431.0528	417.1479	417.1479	431.0528	417.1479	431.0528	417.1479	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	65.3990	63.7514	61.2083	56.4707	53.3461	50.1388	48.5646	50.4871	52.6487	56.1734	60.7529	64.8685	(72)
Total internal gains													
	1379.5668	1431.0874	1362.4965	1326.2050	1251.7918	1208.5570	1157.0476	1150.4965	1187.9164	1222.9950	1298.8630	1343.0062	(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	2.3800	11.2829	0.6300	1.0000	0.7700	11.7239	(75)
Southeast	47.5300	36.7938	0.6300	1.0000	0.7700	763.5133	(77)
Southwest	7.7700	36.7938	0.6300	1.0000	0.7700	124.8159	(79)
Northwest	45.5600	11.2829	0.6300	1.0000	0.7700	224.4294	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	1226.0255	2204.7471	3311.3531	4573.4281	5535.0650	5671.9172	5395.0592	4653.5975	3746.2081	2517.5693	1490.0371	1035.0948	(83)
Total gains	2605.5923	3635.8345	4673.8496	5899.6331	6786.8568	6880.4742	6552.1068	5804.0940	4934.1245	3740.5643	2788.9001	2378.1010	(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	33.3389	33.3709	33.4022	33.5504	33.5783	33.7086	33.7086	33.7329	33.6583	33.5783	33.5219	33.4633	
alpha	3.2226	3.2247	3.2268	3.2367	3.2386	3.2472	3.2472	3.2489	3.2439	3.2386	3.2348	3.2309	
util living area													
	0.9957	0.9874	0.9665	0.9071	0.7919	0.6331	0.4930	0.5630	0.7986	0.9553	0.9910	0.9968	(86)
MIT	18.4377	18.7943	19.3250	19.9923	20.5313	20.8407	20.9475	20.9192	20.6437	19.8875	19.0239	18.3734	(87)
Th 2	20.1270	20.1278	20.1285	20.1321	20.1327	20.1358	20.1358	20.1363	20.1346	20.1327	20.1314	20.1300	(88)
util rest of house													
	0.9950	0.9853	0.9606	0.8905	0.7552	0.5698	0.4075	0.4755	0.7484	0.9444	0.9892	0.9963	(89)
MIT 2	17.7309	18.0866	18.6130	19.2656	19.7687	20.0349	20.1115	20.0963	19.8826	19.1751	18.3192	17.6687	(90)
Living area fraction										fLA = Living area / (4) =		0.0461	(91)
MIT	17.7634	18.1192	18.6459	19.2991	19.8039	20.0721	20.1500	20.1342	19.9177	19.2079	18.3517	17.7012	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7634	18.1192	18.6459	19.2991	19.8039	20.0721	20.1500	20.1342	19.9177	19.2079	18.3517	17.7012	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9919	0.9782	0.9472	0.8711	0.7396	0.5648	0.4090	0.4753	0.7339	0.9287	0.9836	0.9939	(94)
Useful gains	2584.5639	3556.4192	4427.2645	5139.0573	5019.5050	3885.9372	2679.9024	2758.5018	3620.9933	3474.0185	2743.2018	2363.5543	(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													
	10666.4465	10462.9147	9604.3417	8186.8023	6374.5347	4287.7036	2781.6854	2923.8753	4565.3541	6771.0254	8865.5161	10656.6101	(97)
Space heating kWh													
	6012.9206	4641.1650	3851.7455	2194.3764	1008.1421	0.0000	0.0000	0.0000	0.0000	2452.9731	4408.0663	6170.0336	(98a)
Space heating requirement - total per year (kWh/year)												30739.4226	
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													
	6012.9206	4641.1650	3851.7455	2194.3764	1008.1421	0.0000	0.0000	0.0000	0.0000	2452.9731	4408.0663	6170.0336	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												30739.4226	
Space heating per m2											(98c) / (4) =	36.7767	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	7365.5011	5798.3732	5950.8054	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7807	0.8447	0.7958	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5750.0620	4898.1694	4735.8902	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	7688.2259	7319.4675	6475.0240	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	1395.4780	1801.4458	1293.9156	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	348.8695	450.3614	323.4789	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												1122.7098	(107)
Energy for space heating												36.7767	(99)
Energy for space cooling												1.3432	(108)
Total												38.1199	(109)
Fabric Energy Efficiency (DFEE)												38.1	(109)

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

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1. Overall dwelling characteristics

	Area (m2)			Storey height (m)		Volume (m3)	
Basement floor	322.8800	(1a)	x	2.9300 (2a)	=	946.0384	(1a) -
Ground floor	235.0800	(1b)	x	3.3700 (2b)	=	792.2196	(1b) -
First floor	195.9200	(1c)	x	3.3800 (2c)	=	662.2096	(1c) -
Second floor	81.9600	(1d)	x	3.3700 (2d)	=	276.2052	(1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 835.8400							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2676.6728	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0149	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2649	(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) =	0.2649	(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													
	0.3378	0.3312	0.3246	0.2914	0.2848	0.2517	0.2517	0.2451	0.2649	0.2848	0.2981	0.3113	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5571	0.5548	0.5527	0.5425	0.5406	0.5317	0.5317	0.5300	0.5351	0.5406	0.5444	0.5485	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			3.5200	1.0000	3.5200			(26)
TER Opening Type (Uw = 1.20)			103.2400	1.1450	118.2137			(27)
Rooflights			9.8400	2.0221	19.8971			(27a)
GF			4.1700	0.1300	0.5421			(28a)

BASEMENT			322.8800	0.1300	41.9744	(28a)
EXTERNAL	483.0600	106.7600	376.3000	0.1800	67.7340	(29a)
BASEMENT	217.2900		217.2900	0.1800	39.1122	(29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885	(30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076	(30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	(30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481	(30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1100	8.6471	(30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718	(30)
Total net area of external elements Aum(A, m2)			1449.4100			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	336.3322	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.0500	1.9265
E3 Sill	37.6400	0.0500	1.8820
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0000	0.0000
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0800	0.9664
E14 Flat roof	56.1400	0.0800	4.4912
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 34.6263 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 370.9585 (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	492.0483	490.0914	488.1731	479.1632	477.4775	469.6302	469.6302	468.1769	472.6528	477.4775	480.8877	484.4529	(38)
Heat transfer coeff	863.0068	861.0499	859.1316	850.1217	848.4360	840.5887	840.5887	839.1354	843.6113	848.4360	851.8462	855.4114	(39)

Average = Sum(39)m / 12 = 850.1136

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0325	1.0302	1.0279	1.0171	1.0151	1.0057	1.0057	1.0039	1.0093	1.0151	1.0191	1.0234	(40)
HLP (average)												1.0171	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	38.1432	37.5767	36.7790	35.3081	34.2068	32.9855	32.3259	33.1180	33.9805	35.2873	36.7884	38.0142	(42b)
Hot water usage for other uses	53.8379	51.8802	49.9224	47.9647	46.0069	44.0492	44.0492	46.0069	47.9647	49.9224	51.8802	53.8379	(42c)
Average daily hot water use (litres/day)												84.3083	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.9811	89.4569	86.7014	83.2728	80.2137	77.0347	76.3751	79.1250	81.9452	85.2097	88.6686	91.8521	(44)
Energy conte	145.6756	127.3854	133.2568	113.9963	107.9831	94.7232	92.3690	97.9732	101.0466	115.6288	126.3247	143.8182	(45)
Energy content (annual)										Total = Sum(45)m =		1400.1809	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
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	123.8242	108.2776	113.2683	96.8969	91.7856	80.5147	78.5137	83.2772	85.8896	98.2844	107.3760	122.2455	(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	123.8242	108.2776	113.2683	96.8969	91.7856	80.5147	78.5137	83.2772	85.8896	98.2844	107.3760	122.2455	(64)
								Total per year (kWh/year) = Sum(64)m =				1190.1537	(64)
12Total per year (kWh/year)												1190	(64)
Electric shower(s)	70.8031	63.0862	68.8877	65.7387	66.9722	63.8850	66.0145	66.9722	65.7387	68.8877	67.5923	70.8031	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						805.3816	(64a)
Heat gains from water heating, kWh/month	48.6568	42.8409	45.5390	40.6589	39.6895	36.0999	36.1321	37.5624	37.9071	41.7930	43.7421	48.2622	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	443.4680	490.9824	443.4680	458.2502	443.4680	458.2502	443.4680	443.4680	458.2502	443.4680	458.2502	443.4680	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	65.3990	63.7514	61.2083	56.4707	53.3461	50.1388	48.5646	50.4871	52.6487	56.1734	60.7529	64.8685	(72)
Total internal gains													
	1405.8870	1460.2275	1388.8166	1353.4024	1278.1119	1235.7544	1183.3678	1176.8166	1215.1139	1249.3151	1326.0604	1369.3263	(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	2.3800	11.2829	0.6300	0.7000	0.7700	8.2067	(75)
Southeast	47.5300	36.7938	0.6300	0.7000	0.7700	534.4593	(77)
Southwest	7.7700	36.7938	0.6300	0.7000	0.7700	87.3711	(79)
Northwest	45.5600	11.2829	0.6300	0.7000	0.7700	157.1006	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	888.6807	1606.5920	2430.4254	3377.1470	4099.5020	4204.6718	3997.9831	3441.4671	2757.0852	1839.6273	1081.6904	749.1710	(83)
Total gains	2294.5677	3066.8195	3819.2420	4730.5494	5377.6140	5440.4262	5181.3508	4618.2837	3972.1991	3088.9425	2407.7508	2118.4973	(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	30.6056	30.6752	30.7437	31.0695	31.1312	31.4218	31.4218	31.4763	31.3093	31.1312	31.0066	30.8774	
alpha	3.0404	3.0450	3.0496	3.0713	3.0754	3.0948	3.0948	3.0984	3.0873	3.0754	3.0671	3.0585	
util living area													
	0.9968	0.9921	0.9810	0.9481	0.8761	0.7515	0.6177	0.6846	0.8765	0.9739	0.9940	0.9976	(86)
MIT	18.1613	18.4647	18.9575	19.6348	20.2513	20.6950	20.8823	20.8349	20.4480	19.6305	18.7783	18.1215	(87)
Th 2	20.0563	20.0583	20.0602	20.0691	20.0708	20.0786	20.0786	20.0800	20.0756	20.0708	20.0674	20.0639	(88)
util rest of house													
	0.9963	0.9907	0.9773	0.9373	0.8478	0.6896	0.5180	0.5899	0.8368	0.9668	0.9927	0.9971	(89)
MIT 2	17.4080	17.7120	18.2037	18.8781	19.4719	19.8770	20.0219	19.9940	19.6704	18.8818	18.0318	17.3732	(90)
Living area fraction										fLA = Living area / (4) =		0.0461	(91)
MIT	17.4427	17.7467	18.2384	18.9129	19.5078	19.9147	20.0616	20.0328	19.7062	18.9163	18.0662	17.4077	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4427	17.7467	18.2384	18.9129	19.5078	19.9147	20.0616	20.0328	19.7062	18.9163	18.0662	17.4077	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9938	0.9854	0.9672	0.9195	0.8269	0.6770	0.5160	0.5843	0.8168	0.9541	0.9883	0.9951	(94)
Useful gains	2280.3375	3021.9824	3693.9609	4349.8064	4446.5966	3683.3158	2673.6049	2698.5693	3244.4216	2947.1370	2379.6970	2108.1960	(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													
	11342.2293	11061.6179	10084.8529	8512.1970	6624.4572	4467.4776	2909.7518	3048.3828	4729.4893	7055.8535	9341.4822	11298.0073	(97)
Space heating kWh													
	6742.0475	5402.6351	4754.8236	2996.9212	1620.3283	0.0000	0.0000	0.0000	0.0000	3056.8851	5012.4854	6837.2196	(98a)
Space heating requirement - total per year (kWh/year)												36423.3457	
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													
	6742.0475	5402.6351	4754.8236	2996.9212	1620.3283	0.0000	0.0000	0.0000	0.0000	3056.8851	5012.4854	6837.2196	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												36423.3457	
Space heating per m2											(98c) / (4) =	43.5769	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

	0.0000	0.0000	0.0000	0.0000	0.0000	7901.5333	6220.3560	6377.4294	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6423	0.7211	0.6629	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5075.2797	4485.2850	4227.7585	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5975.5666	5689.0097	5061.4827	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	648.2066	895.5712	620.2908	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	162.0516	223.8928	155.0727	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												541.0172	(107)
Energy for space heating												43.5769	(99)
Energy for space cooling												0.6473	(108)
Total												44.2242	(109)
Fabric Energy Efficiency (TFEE)												44.2	(109)

Full SAP Calculation Printout

elmhurst energy

Property Reference	Proposed 63	Issued on Date	15/05/2023
Assessment Reference	Heatpump	Prop Type Ref	63 SHELDON
Property	63, Sheldon Avenue, LONDON, N6 4NH		

SAP Rating	89 B	DER	1.81	TER	7.73
Environmental	98 A	% DER < TER			76.58
CO_2 Emissions (t/year)	1.37	DFEE	38.12	TFEE	44.22
Compliance Check	See BREL	% DFEE < TFEE			13.80
% DPER < TPER	55.73	DPER	18.49	TPER	41.76

Assessor Details	Mr. Mark Simons	Assessor ID	5542-0001
Client	EALConsult, Mark Simons		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	322.8800	(1a) x	2.9300	(2a) =	946.0384	(1a) -
Ground floor	235.0800	(1b) x	3.3700	(2b) =	792.2196	(1b) -
First floor	195.9200	(1c) x	3.3800	(2c) =	662.2096	(1c) -
Second floor	81.9600	(1d) x	3.3700	(2d) =	276.2052	(1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	835.8400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	2676.6728	(5)

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	10 * 10 =	100.0000	(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) =	100.0000 / (5) =	0.0374	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1874	(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) =	0.1874	(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	0.2389	0.2342	0.2295	0.2061	0.2014	0.1780	0.1780	0.1733	0.1874	0.2014	0.2108	0.2201	(22b)
Effective ac	0.5285	0.5274	0.5263	0.5212	0.5203	0.5158	0.5158	0.5150	0.5176	0.5203	0.5222	0.5242	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			103.2400	1.0536	108.7778			(27)
Entrance Door			3.5200	1.1000	3.8720			(26)
Rooflights			9.8400	1.0536	10.3678			(27a)
GF			4.1700	0.1000	0.4170	110.0000	458.7000	(28a)
BASEMENT			322.8800	0.1000	32.2880	110.0000	35516.8000	(28a)

EXTERNAL	483.0600	106.7600	376.3000	0.1400	52.6820	70.0000	26341.0000 (29a)
BASEMENT	217.2900		217.2900	0.1400	30.4206	70.0000	15210.3000 (29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885	9.0000	318.1500 (30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076	9.0000	352.4400 (30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	9.0000	701.6400 (30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481	9.0000	609.3900 (30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1043	8.1963	9.0000	707.4900 (30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718	9.0000	1020.4200 (30)

Total net area of external elements Aum(A, m2) 1449.4100 (31)
Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 283.7131 (33)

Internal Floor GF	235.0800	18.0000	4231.4400 (32d)
Internal Floor FF	195.9200	18.0000	3526.5600 (32d)
Internal Floor SF	81.9600	18.0000	1475.2800 (32d)
Internal Ceiling LGF	235.0800	9.0000	2115.7200 (32e)
Internal Ceiling GF	195.9200	9.0000	1763.2800 (32e)
Internal Ceiling FF	81.9600	9.0000	737.6400 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 95086.2500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.3000	11.5590
E3 Sill	37.6400	0.0400	1.5056
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0700	6.2020
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0400	0.4832
E14 Flat roof	56.1400	0.0400	2.2456
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 47.3556 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 331.0687 (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	466.8540	465.8754	464.9161	460.4103	459.5673	455.6430	455.6430	454.9163	457.1546	459.5673	461.2727	463.0556	(38)
Heat transfer coeff	797.9227	796.9441	795.9848	791.4790	790.6360	786.7117	786.7117	785.9850	788.2233	790.6360	792.3414	794.1243	(39)

Average = Sum(39)m / 12 = 791.4750

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9546	0.9535	0.9523	0.9469	0.9459	0.9412	0.9412	0.9404	0.9430	0.9459	0.9480	0.9501	(40)
HLP (average)												0.9469	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

Hot water usage for mixer showers	88.4118	87.0832	85.1471	81.4426	78.7089	75.6602	73.9274	75.8488	77.9551	81.2284	85.0124	88.0731	(42a)
Hot water usage for baths	40.1507	39.5544	38.7147	37.1665	36.0071	34.7216	34.0273	34.8611	35.7690	37.1445	38.7247	40.0150	(42b)
Hot water usage for other uses	56.6715	54.6107	52.5499	50.4891	48.4283	46.3676	46.3676	48.4283	50.4891	52.5499	54.6107	56.6715	(42c)

Average daily hot water use (litres/day) 170.2583 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	185.2340	181.2483	176.4117	169.0982	163.1444	156.7494	154.3222	159.1383	164.2132	170.9229	178.3478	184.7595	(44)
Energy conte	293.3654	258.0952	271.1382	231.4870	219.6237	192.7417	186.6393	197.0464	202.4913	231.9407	254.0891	289.2888	(45)

Energy content (annual) Total = Sum(45)m = 2827.9468

Distribution loss (46)m = 0.15 x (45)m	44.0048	38.7143	40.6707	34.7231	32.9436	28.9113	27.9959	29.5570	30.3737	34.7911	38.1134	43.3933	(46)

Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.1000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1340 (55)

Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(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	351.7818	310.8584	329.5546	288.0190	278.0401	249.2737	245.0557	255.4628	259.0233	290.3571	310.6211	347.7052	(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	351.7818	310.8584	329.5546	288.0190	278.0401	249.2737	245.0557	255.4628	259.0233	290.3571	310.6211	347.7052	(64)

Total per year (kWh/year) = Sum(64)m = 3515.7528 (64)

12Total per year (kWh/year) 3516 (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

144.2771	128.0272	136.8866	122.1950	119.7580	109.3122	108.7907	112.2510	112.5540	123.8534	129.7102	142.9216	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	417.1479	461.8423	417.1479	431.0528	417.1479	431.0528	417.1479	417.1479	431.0528	417.1479	431.0528	417.1479	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	193.9209	190.5167	183.9873	169.7153	160.9650	151.8225	146.2240	150.8751	156.3249	166.4696	180.1531	192.0990	(72)
Total internal gains													
	1508.0887	1557.8526	1485.2755	1439.4496	1359.4108	1310.2407	1254.7071	1250.8845	1291.5927	1333.2912	1418.2632	1470.2366	(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	2.3800	11.2829	0.6300	1.0000	0.7700	11.7239	(75)
Southeast	47.5300	36.7938	0.6300	1.0000	0.7700	763.5133	(77)
Southwest	7.7700	36.7938	0.6300	1.0000	0.7700	124.8159	(79)
Northwest	45.5600	11.2829	0.6300	1.0000	0.7700	224.4294	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	1226.0255	2204.7471	3311.3531	4573.4281	5535.0650	5671.9172	5395.0592	4653.5975	3746.2081	2517.5693	1490.0371	1035.0948	(83)
Total gains	2734.1142	3762.5997	4796.6285	6012.8777	6894.4758	6982.1579	6649.7663	5904.4820	5037.8007	3850.8606	2908.3003	2505.3315	(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	33.1020	33.1427	33.1826	33.3715	33.4071	33.5737	33.5737	33.6048	33.5093	33.4071	33.3352	33.2603	
alpha	3.2068	3.2095	3.2122	3.2248	3.2271	3.2382	3.2382	3.2403	3.2340	3.2271	3.2223	3.2174	
util living area													
	0.9950	0.9861	0.9643	0.9035	0.7874	0.6281	0.4884	0.5570	0.7922	0.9521	0.9899	0.9963	(86)
Living	18.9925	19.2595	19.6565	20.1557	20.5568	20.7874	20.8663	20.8459	20.6429	20.0809	19.4349	18.9464	
Non living	17.7070	18.0487	18.5540	19.1806	19.6604	19.9154	19.9879	19.9740	19.7722	19.0988	18.2776	17.6506	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	0	0	0	0	0	0	0	0	0	0	14	
16 / 9	0	28	31	0	0	0	0	0	0	0	21	17	
MIT	21.0000	20.0142	20.2391	20.1557	20.5568	20.7874	20.8663	20.8459	20.6429	20.0809	19.9099	20.3622	(87)
Th 2	20.1213	20.1223	20.1233	20.1278	20.1286	20.1326	20.1326	20.1333	20.1311	20.1286	20.1269	20.1251	(88)
util rest of house													
	0.9942	0.9838	0.9581	0.8864	0.7503	0.5646	0.4031	0.4696	0.7412	0.9405	0.9878	0.9956	(89)
MIT 2	20.1213	19.2071	19.4306	19.1806	19.6604	19.9154	19.9879	19.9740	19.7722	19.0988	19.0007	19.5262	(90)
Living area fraction										fLA = Living area / (4) =		0.0461	(91)
MIT	20.1618	19.2442	19.4679	19.2255	19.7017	19.9556	20.0283	20.0142	19.8123	19.1440	19.0426	19.5647	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1618	19.2442	19.4679	19.2255	19.7017	19.9556	20.0283	20.0142	19.8123	19.1440	19.0426	19.5647	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9942	0.9809	0.9525	0.8648	0.7296	0.5506	0.3923	0.4567	0.7193	0.9227	0.9844	0.9951	(94)
Useful gains	2718.3492	3690.6201	4568.6080	5199.8585	5030.4468	3844.4274	2608.9182	2696.5322	3623.5971	3553.2471	2862.9995	2493.0990	(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													
	12656.4848	11431.5629	10322.2134	8172.4515	6326.4559	4213.3082	2697.1198	2840.6877	4502.5923	6755.2034	9462.6259	12201.4730	(97)
Space heating kWh													
	7393.9729	5201.9136	4280.6824	2140.2670	964.2308	0.0000	0.0000	0.0000	0.0000	2382.2555	4751.7310	7223.0303	(98a)
Space heating requirement - total per year (kWh/year)												34338.0835	
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													
	7393.9729	5201.9136	4280.6824	2140.2670	964.2308	0.0000	0.0000	0.0000	0.0000	2382.2555	4751.7310	7223.0303	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												34338.0835	
Space heating per m2											(98c) / (4) =	41.0821	(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 %)	437.7710	(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													
	7393.9729	5201.9136	4280.6824	2140.2670	964.2308	0.0000	0.0000	0.0000	0.0000	2382.2555	4751.7310	7223.0303	(98)
Space heating efficiency (main heating system 1)													
	437.7710	437.7710	437.7710	437.7710	437.7710	0.0000	0.0000	0.0000	0.0000	437.7710	437.7710	437.7710	(210)
Space heating fuel (main heating system)													
	1689.0048	1188.2728	977.8361	488.9011	220.2592	0.0000	0.0000	0.0000	0.0000	544.1785	1085.4377	1649.9564	(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													
	351.7818	310.8584	329.5546	288.0190	278.0401	249.2737	245.0557	255.4628	259.0233	290.3571	310.6211	347.7052	(64)
Efficiency of water heater												287.4489	(216)
(217)m	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	(217)
Fuel for water heating, kWh/month													
	122.3806	108.1439	114.6481	100.1983	96.7268	86.7193	85.2519	88.8724	90.1111	101.0117	108.0613	120.9624	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	99.0824	79.4876	71.5698	52.4351	40.5024	33.0908	36.9476	48.0259	62.3809	81.8471	92.4461	101.8362	(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	7843.8465	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	287.4489	
Water heating fuel used	1223.0878	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	799.6518	(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	9866.5862	(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	7843.8465	0.1556	1220.8797	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1223.0878	0.1410	172.4768	(264)
Space and water heating			1393.3565	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	799.6518	0.1443	115.4145	(268)
Total CO2, kg/year			1508.7709	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.8100	(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	7843.8465	1.5762	12363.5818	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1223.0878	1.5214	1860.8515	(278)
Space and water heating			14224.4333	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	799.6518	1.5338	1226.5327	(282)
Total Primary energy kWh/year			15450.9660	(286)
Dwelling Primary energy Rate (DPER)			18.4900	(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)	
Basement floor	322.8800 (1a)	x	2.9300 (2a)	=	946.0384 (1a)	-
Ground floor	235.0800 (1b)	x	3.7700 (2b)	=	792.2196 (1b)	-
First floor	195.9200 (1c)	x	3.3800 (2c)	=	662.2096 (1c)	-
Second floor	81.9600 (1d)	x	3.3700 (2d)	=	276.2052 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 835.8400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2676.6728	(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) =	0.0149	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2649	(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) =	0.2649	(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	0.3378	0.3312	0.3246	0.2914	0.2848	0.2517	0.2517	0.2451	0.2649	0.2848	0.2981	0.3113	(22b)
Effective ac	0.5571	0.5548	0.5527	0.5425	0.5406	0.5317	0.5317	0.5300	0.5351	0.5406	0.5444	0.5485	(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			3.5200	1.0000	3.5200			(26)
TER Opening Type (Uw = 1.20)			103.2400	1.1450	118.2137			(27)
Rooflights			9.8400	2.0221	19.8971			(27a)
GF			4.1700	0.1300	0.5421			(28a)
BASEMENT			322.8800	0.1300	41.9744			(28a)
EXTERNAL	483.0600	106.7600	376.3000	0.1800	67.7340			(29a)
BASEMENT	217.2900		217.2900	0.1800	39.1122			(29a)

Flat Roof FF	35.3500		35.3500	0.1100	3.8885	(30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076	(30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	(30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481	(30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1100	8.6471	(30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718	(30)
Total net area of external elements Aum(A, m2)			1449.4100			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	336.3322	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.0500	1.9265
E3 Sill	37.6400	0.0500	1.8820
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0000	0.0000
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0800	0.9664
E14 Flat roof	56.1400	0.0800	4.4912
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 34.6263 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 370.9585 (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	492.0483	490.0914	488.1731	479.1632	477.4775	469.6302	469.6302	468.1769	472.6528	477.4775	480.8877	484.4529	(38)
Heat transfer coeff	863.0068	861.0499	859.1316	850.1217	848.4360	840.5887	840.5887	839.1354	843.6113	848.4360	851.8462	855.4114	(39)

Average = Sum(39)m / 12 = 850.1136

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0325	1.0302	1.0279	1.0171	1.0151	1.0057	1.0057	1.0039	1.0093	1.0151	1.0191	1.0234	(40)
HLP (average)												1.0171	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	88.4118	87.0832	85.1471	81.4426	78.7089	75.6602	73.9274	75.8488	77.9551	81.2284	85.0124	88.0731	(42a)
Hot water usage for baths	38.1432	37.5767	36.7790	35.3081	34.2068	32.9855	32.3259	33.1180	33.9805	35.2873	36.7884	38.0142	(42b)
Hot water usage for other uses	53.8379	51.8802	49.9224	47.9647	46.0069	44.0492	44.0492	46.0069	47.9647	49.9224	51.8802	53.8379	(42c)
Average daily hot water use (litres/day)												165.8210	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	180.3929	176.5400	171.8485	164.7155	158.9226	152.6950	150.3024	154.9738	159.9003	166.4381	173.6810	179.9252	(44)
Energy conte	285.6983	251.3907	264.1247	225.4872	213.9404	187.7563	181.7778	191.8899	197.1731	225.8550	247.4404	281.7194	(45)
Energy content (annual)										Total = Sum(45)m =		2754.2531	
Distribution loss (46)m = 0.15 x (45)m	42.8547	37.7086	39.6187	33.8231	32.0911	28.1634	27.2667	28.7835	29.5760	33.8782	37.1161	42.2579	(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	344.3271	304.3457	322.7535	282.2248	272.5692	244.4938	240.4066	250.5187	253.9106	284.4838	304.1780	340.3482	(62)
WWHRS	-40.4182	-35.7462	-37.4313	-30.9946	-28.8859	-24.7179	-23.1690	-24.6380	-25.5740	-30.1490	-34.1551	-39.6697	(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	303.9089	268.5995	285.3221	251.2301	243.6833	219.7760	217.2375	225.8808	228.3366	254.3348	270.0229	300.6785	(64)
									Total per year (kWh/year) = Sum(64)m =			3069.0111	(64)
12Total per year (kWh/year)												3069	(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	141.8977	125.9514	134.7245	120.3645	118.0382	107.8190	107.3442	110.7064	110.9501	121.9998	127.6640	140.5748	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	443.4680	490.9824	443.4680	458.2502	443.4680	458.2502	443.4680	443.4680	458.2502	443.4680	458.2502	443.4680	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	190.7228	187.4277	181.0813	167.1730	158.6535	149.7486	144.2798	148.7990	154.0974	163.9783	177.3111	188.9446	(72)
Total internal gains													
	1534.2107	1586.9038	1511.6896	1467.1047	1386.4194	1335.3643	1279.0830	1275.1285	1316.5625	1360.1200	1445.6187	1496.4023	(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	2.3800	11.2829	0.6300	0.7000	0.7700	8.2067	(75)
Southeast	47.5300	36.7938	0.6300	0.7000	0.7700	534.4593	(77)
Southwest	7.7700	36.7938	0.6300	0.7000	0.7700	87.3711	(79)
Northwest	45.5600	11.2829	0.6300	0.7000	0.7700	157.1006	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	888.6807	1606.5920	2430.4254	3377.1470	4099.5020	4204.6718	3997.9831	3441.4671	2757.0852	1839.6273	1081.6904	749.1710	(83)
Total gains	2422.8914	3193.4958	3942.1150	4844.2517	5485.9214	5540.0361	5277.0660	4716.5956	4073.6477	3199.7473	2527.3090	2245.5733	(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	30.6056	30.6752	30.7437	31.0695	31.1312	31.4218	31.4218	31.4763	31.3093	31.1312	31.0066	30.8774	
alpha	3.0404	3.0450	3.0496	3.0713	3.0754	3.0948	3.0948	3.0984	3.0873	3.0754	3.0671	3.0585	
util living area													
	0.9963	0.9912	0.9793	0.9451	0.8710	0.7446	0.6099	0.6758	0.8701	0.9714	0.9931	0.9971	(86)
MIT	18.1909	18.4935	18.9842	19.6567	20.2672	20.7036	20.8865	20.8410	20.4629	19.6541	18.8057	18.1510	(87)
Th 2	20.0563	20.0583	20.0602	20.0691	20.0708	20.0786	20.0786	20.0800	20.0756	20.0708	20.0674	20.0639	(88)
util rest of house													
	0.9957	0.9896	0.9754	0.9337	0.8420	0.6821	0.5105	0.5808	0.8290	0.9637	0.9916	0.9966	(89)
MIT 2	16.6960	17.0842	17.7118	18.5677	19.3205	19.8281	20.0088	19.9744	19.5718	18.5745	17.4903	16.6491	(90)
Living area fraction										fLA = Living area / (4) =		0.0461	(91)
MIT	16.7648	17.1492	17.7704	18.6179	19.3641	19.8685	20.0492	20.0143	19.6129	18.6242	17.5509	16.7183	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.7648	17.1492	17.7704	18.6179	19.3641	19.8685	20.0492	20.0143	19.6129	18.6242	17.5509	16.7183	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9815	0.9607	0.9094	0.8146	0.6658	0.5070	0.5732	0.8029	0.9455	0.9849	0.9933	(94)
Useful gains	2402.6463	3134.4556	3787.1993	4405.4208	4468.6858	3688.3950	2675.3861	2703.3218	3270.5765	3025.3898	2489.0290	2230.6101	(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													
	10757.2410	10547.1325	9682.7758	8261.4059	6502.4775	4428.6125	2899.3909	3032.8844	4650.7386	6808.0456	8902.5699	10708.2830	(97)
Space heating kWh													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(98a)
Space heating requirement - total per year (kWh/year)												33612.3305	
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													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												33612.3305	
Space heating per m2											(98c) / (4) =	40.2138	(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													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(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)													
	6734.3645	5396.8785	4752.2307	3007.9190	1639.3728	0.0000	0.0000	0.0000	0.0000	3049.0747	5002.9788	6833.5738	(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													
	303.9089	268.5995	285.3221	251.2301	243.6833	219.7760	217.2375	225.8808	228.3366	254.3348	270.0229	300.6785	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.3356	88.2905	88.1925	87.9766	87.4322	79.8000	79.8000	79.8000	79.8000	87.9776	88.2501	88.3466	(217)
Fuel for water heating, kWh/month													
	344.0390	304.2223	323.5220	285.5646	278.7110	275.4085	272.2275	283.0586	286.1361	289.0904	305.9744	340.3396	(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	92.1439	73.9212	66.5579	48.7632	37.6661	30.7735	34.3602	44.6628	58.0125	76.1155	85.9723	94.7048	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-236.8929	-305.5310	-401.6282	-410.9453	-410.5931	-370.9295	-365.0299	-358.9818	-346.0060	-327.0440	-249.4235	-208.1750	(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	-235.8670	-479.4048	-924.2432	-1349.4061	-1749.2625	-1746.3020	-1726.8735	-1478.7804	-1105.8513	-673.4567	-310.5655	-187.9600	(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	36416.3928	(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	3588.2938	(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)	743.6540	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-15959.1530	(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	24875.1876	(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	36416.3928	0.2100	7647.4425	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3588.2938	0.2100	753.5417	(264)
Space and water heating			8400.9842	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	743.6540	0.1443	107.3322	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3991.1800	0.1367	-545.4331	
PV Unit electricity exported	-11967.9730	0.1267	-1516.7747	
Total			-2062.2078	(269)
Total CO2, kg/year			6458.0379	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.7300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	36416.3928	1.1300	41150.5238	(275)

Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3588.2938	1.1300	4054.7720	(278)
Space and water heating			45205.2959	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	743.6540	1.5338	1140.6413	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3991.1800	1.5052	-6007.4585	
PV Unit electricity exported	-11967.9730	0.4652	-5568.0282	
Total			-11575.4867	(283)
Total Primary energy kWh/year			34900.5512	(286)
Target Primary Energy Rate (TPER)			41.7600	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	322.8800 (1a)	x	2.9300 (2a)	=	946.0384 (1a)	-
Ground floor	235.0800 (1b)	x	3.7300 (2b)	=	792.2196 (1b)	-
First floor	195.9200 (1c)	x	3.3800 (2c)	=	662.2096 (1c)	-
Second floor	81.9600 (1d)	x	3.7300 (2d)	=	276.2052 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 835.8400					(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2676.6728 (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) =	0.0149	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1649	(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) =	0.1649	(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	0.2103	0.2062	0.2021	0.1814	0.1773	0.1567	0.1567	0.1526	0.1649	0.1773	0.1856	0.1938	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5221	0.5213	0.5204	0.5165	0.5157	0.5123	0.5123	0.5116	0.5136	0.5157	0.5172	0.5188	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			103.2400	1.0536	108.7778			(27)
Entrance Door			3.5200	1.1000	3.8720			(26)
Rooflights			9.8400	1.0536	10.3678			(27a)
GF			4.1700	0.1000	0.4170	110.0000	458.7000	(28a)
BASEMENT			322.8800	0.1000	32.2880	110.0000	35516.8000	(28a)
EXTERNAL	483.0600	106.7600	376.3000	0.1400	52.6820	70.0000	26341.0000	(29a)
BASEMENT	217.2900		217.2900	0.1400	30.4206	70.0000	15210.3000	(29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885	9.0000	318.1500	(30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076	9.0000	352.4400	(30)

Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	9.0000	701.6400 (30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481	9.0000	609.3900 (30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1043	8.1963	9.0000	707.4900 (30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718	9.0000	1020.4200 (30)
Total net area of external elements Aum(A, m2)			1449.4100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	283.7131		(33)
Internal Floor GF			235.0800			18.0000	4231.4400 (32d)
Internal Floor FF			195.9200			18.0000	3526.5600 (32d)
Internal Floor SF			81.9600			18.0000	1475.2800 (32d)
Internal Ceiling LGF			235.0800			9.0000	2115.7200 (32e)
Internal Ceiling GF			195.9200			9.0000	1763.2800 (32e)
Internal Ceiling FF			81.9600			9.0000	737.6400 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 95086.2500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.3000	11.5590
E3 Sill	37.6400	0.0400	1.5056
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0700	6.2020
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0400	0.4832
E14 Flat roof	56.1400	0.0400	2.2456
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 47.3556 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 331.0687 (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	461.1842	460.4257	459.6822	456.1901	455.5367	452.4953	452.4953	451.9320	453.6668	455.5367	456.8585	458.2403	(38)
Heat transfer coeff													
	792.2529	791.4944	790.7509	787.2588	786.6054	783.5639	783.5639	783.0007	784.7355	786.6054	787.9272	789.3090	(39)
Average = Sum(39)m / 12 =												787.2557	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9479	0.9469	0.9461	0.9419	0.9411	0.9375	0.9375	0.9368	0.9389	0.9411	0.9427	0.9443	(40)
HLP (average)												0.9419	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)
Hot water usage for mixer showers

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	38.1432	37.5767	36.7790	35.3081	34.2068	32.9855	32.3259	33.1180	33.9805	35.2873	36.7884	38.0142	(42b)
Hot water usage for other uses													
	53.8379	51.8802	49.9224	47.9647	46.0069	44.0492	44.0492	46.0069	47.9647	49.9224	51.8802	53.8379	(42c)
Average daily hot water use (litres/day)												84.3083	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	91.9811	89.4569	86.7014	83.2728	80.2137	77.0347	76.3751	79.1250	81.9452	85.2097	88.6686	91.8521	(44)
Energy conte	145.6756	127.3854	133.2568	113.9963	107.9831	94.7232	92.3690	97.9732	101.0466	115.6288	126.3247	143.8182	(45)
Energy content (annual)										Total = Sum(45)m =		1400.1809	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
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													
	123.8242	108.2776	113.2683	96.8969	91.7856	80.5147	78.5137	83.2772	85.8896	98.2844	107.3760	122.2455	(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													
	123.8242	108.2776	113.2683	96.8969	91.7856	80.5147	78.5137	83.2772	85.8896	98.2844	107.3760	122.2455	(64)
									Total per year (kWh/year) = Sum(64)m =			1190.1537	(64)
12Total per year (kWh/year)												1190	(64)
Electric shower(s)													
	70.8031	63.0862	68.8877	65.7387	66.9722	63.8850	66.0145	66.9722	65.7387	68.8877	67.5923	70.8031	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						805.3816	(64a)
Heat gains from water heating, kWh/month													
	48.6568	42.8409	45.5390	40.6589	39.6895	36.0999	36.1321	37.5624	37.9071	41.7930	43.7421	48.2622	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	417.1479	461.8423	417.1479	431.0528	417.1479	431.0528	417.1479	417.1479	431.0528	417.1479	431.0528	417.1479	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	65.3990	63.7514	61.2083	56.4707	53.3461	50.1388	48.5646	50.4871	52.6487	56.1734	60.7529	64.8685	(72)
Total internal gains													
	1379.5668	1431.0874	1362.4965	1326.2050	1251.7918	1208.5570	1157.0476	1150.4965	1187.9164	1222.9950	1298.8630	1343.0062	(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	2.3800	11.2829	0.6300	1.0000	0.7700	11.7239	(75)
Southeast	47.5300	36.7938	0.6300	1.0000	0.7700	763.5133	(77)
Southwest	7.7700	36.7938	0.6300	1.0000	0.7700	124.8159	(79)
Northwest	45.5600	11.2829	0.6300	1.0000	0.7700	224.4294	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	1226.0255	2204.7471	3311.3531	4573.4281	5535.0650	5671.9172	5395.0592	4653.5975	3746.2081	2517.5693	1490.0371	1035.0948	(83)
Total gains	2605.5923	3635.8345	4673.8496	5899.6331	6786.8568	6880.4742	6552.1068	5804.0940	4934.1245	3740.5643	2788.9001	2378.1010	(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	33.3389	33.3709	33.4022	33.5504	33.5783	33.7086	33.7086	33.7329	33.6583	33.5783	33.5219	33.4633	
alpha	3.2226	3.2247	3.2268	3.2367	3.2386	3.2472	3.2472	3.2489	3.2439	3.2386	3.2348	3.2309	
util living area													
	0.9957	0.9874	0.9665	0.9071	0.7919	0.6331	0.4930	0.5630	0.7986	0.9553	0.9910	0.9968	(86)
MIT	18.4377	18.7943	19.3250	19.9923	20.5313	20.8407	20.9475	20.9192	20.6437	19.8875	19.0239	18.3734	(87)
Th 2	20.1270	20.1278	20.1285	20.1321	20.1327	20.1358	20.1358	20.1363	20.1346	20.1327	20.1314	20.1300	(88)
util rest of house													
	0.9950	0.9853	0.9606	0.8905	0.7552	0.5698	0.4075	0.4755	0.7484	0.9444	0.9892	0.9963	(89)
MIT 2	17.7309	18.0866	18.6130	19.2656	19.7687	20.0349	20.1115	20.0963	19.8826	19.1751	18.3192	17.6687	(90)
Living area fraction										fLA = Living area / (4) =		0.0461	(91)
MIT	17.7634	18.1192	18.6459	19.2991	19.8039	20.0721	20.1500	20.1342	19.9177	19.2079	18.3517	17.7012	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7634	18.1192	18.6459	19.2991	19.8039	20.0721	20.1500	20.1342	19.9177	19.2079	18.3517	17.7012	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9919	0.9782	0.9472	0.8711	0.7396	0.5648	0.4090	0.4753	0.7339	0.9287	0.9836	0.9939	(94)
Useful gains	2584.5639	3556.4192	4427.2645	5139.0573	5019.5050	3885.9372	2679.9024	2758.5018	3620.9933	3474.0185	2743.2018	2363.5543	(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													
	10666.4465	10462.9147	9604.3417	8186.8023	6374.5347	4287.7036	2781.6854	2923.8753	4565.3541	6771.0254	8865.5161	10656.6101	(97)
Space heating kWh													
	6012.9206	4641.1650	3851.7455	2194.3764	1008.1421	0.0000	0.0000	0.0000	0.0000	2452.9731	4408.0663	6170.0336	(98a)
Space heating requirement - total per year (kWh/year)												30739.4226	
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													
	6012.9206	4641.1650	3851.7455	2194.3764	1008.1421	0.0000	0.0000	0.0000	0.0000	2452.9731	4408.0663	6170.0336	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												30739.4226	
Space heating per m2											(98c) / (4) =	36.7767	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	7365.5011	5798.3732	5950.8054	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7807	0.8447	0.7958	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5750.0620	4898.1694	4735.8902	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	7688.2259	7319.4675	6475.0240	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	1395.4780	1801.4458	1293.9156	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	348.8695	450.3614	323.4789	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												1122.7098	(107)
Energy for space heating												36.7767	(99)
Energy for space cooling												1.3432	(108)
Total												38.1199	(109)
Fabric Energy Efficiency (DFEE)												38.1	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	322.8800	(1a) x	2.9300	(2a) =	946.0384	(1a) -
Ground floor	235.0800	(1b) x	3.7300	(2b) =	792.2196	(1b) -
First floor	195.9200	(1c) x	3.3800	(2c) =	662.2096	(1c) -
Second floor	81.9600	(1d) x	3.3700	(2d) =	276.2052	(1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	835.8400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	2676.6728	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0149	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2649	(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) =	0.2649	(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													
	0.3378	0.3312	0.3246	0.2914	0.2848	0.2517	0.2517	0.2451	0.2649	0.2848	0.2981	0.3113	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5571	0.5548	0.5527	0.5425	0.5406	0.5317	0.5317	0.5300	0.5351	0.5406	0.5444	0.5485	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			3.5200	1.0000	3.5200			(26)
TER Opening Type (Uw = 1.20)			103.2400	1.1450	118.2137			(27)
Rooflights			9.8400	2.0221	19.8971			(27a)

GF			4.1700	0.1300	0.5421	(28a)
BASEMENT			322.8800	0.1300	41.9744	(28a)
EXTERNAL	483.0600	106.7600	376.3000	0.1800	67.7340	(29a)
BASEMENT	217.2900		217.2900	0.1800	39.1122	(29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885	(30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076	(30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	(30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481	(30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1100	8.6471	(30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718	(30)
Total net area of external elements Aum(A, m2)			1449.4100			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		336.3322	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.0500	1.9265
E3 Sill	37.6400	0.0500	1.8820
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0000	0.0000
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0800	0.9664
E14 Flat roof	56.1400	0.0800	4.4912
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 34.6263 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 370.9585 (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	492.0483	490.0914	488.1731	479.1632	477.4775	469.6302	469.6302	468.1769	472.6528	477.4775	480.8877	484.4529	(38)
Heat transfer coeff	863.0068	861.0499	859.1316	850.1217	848.4360	840.5887	840.5887	839.1354	843.6113	848.4360	851.8462	855.4114	(39)

Average = Sum(39)m / 12 = 850.1136

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0325	1.0302	1.0279	1.0171	1.0151	1.0057	1.0057	1.0039	1.0093	1.0151	1.0191	1.0234	(40)
HLP (average)												1.0171	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	38.1432	37.5767	36.7790	35.3081	34.2068	32.9855	32.3259	33.1180	33.9805	35.2873	36.7884	38.0142	(42b)
Hot water usage for other uses	53.8379	51.8802	49.9224	47.9647	46.0069	44.0492	44.0492	46.0069	47.9647	49.9224	51.8802	53.8379	(42c)
Average daily hot water use (litres/day)												84.3083	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.9811	89.4569	86.7014	83.2728	80.2137	77.0347	76.3751	79.1250	81.9452	85.2097	88.6686	91.8521	(44)
Energy conte	145.6756	127.3854	133.2568	113.9963	107.9831	94.7232	92.3690	97.9732	101.0466	115.6288	126.3247	143.8182	(45)
Energy content (annual)										Total = Sum(45)m =		1400.1809	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
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	123.8242	108.2776	113.2683	96.8969	91.7856	80.5147	78.5137	83.2772	85.8896	98.2844	107.3760	122.2455	(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	123.8242	108.2776	113.2683	96.8969	91.7856	80.5147	78.5137	83.2772	85.8896	98.2844	107.3760	122.2455	(64)
								Total per year (kWh/year) = Sum(64)m =				1190.1537	(64)
12Total per year (kWh/year)												1190	(64)
Electric shower(s)	70.8031	63.0862	68.8877	65.7387	66.9722	63.8850	66.0145	66.9722	65.7387	68.8877	67.5923	70.8031	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						805.3816	(64a)
Heat gains from water heating, kWh/month	48.6568	42.8409	45.5390	40.6589	39.6895	36.0999	36.1321	37.5624	37.9071	41.7930	43.7421	48.2622	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	443.4680	490.9824	443.4680	458.2502	443.4680	458.2502	443.4680	443.4680	458.2502	443.4680	458.2502	443.4680	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	65.3990	63.7514	61.2083	56.4707	53.3461	50.1388	48.5646	50.4871	52.6487	56.1734	60.7529	64.8685	(72)
Total internal gains													
	1405.8870	1460.2275	1388.8166	1353.4024	1278.1119	1235.7544	1183.3678	1176.8166	1215.1139	1249.3151	1326.0604	1369.3263	(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	2.3800	11.2829	0.6300	0.7000	0.7700	8.2067	(75)
Southeast	47.5300	36.7938	0.6300	0.7000	0.7700	534.4593	(77)
Southwest	7.7700	36.7938	0.6300	0.7000	0.7700	87.3711	(79)
Northwest	45.5600	11.2829	0.6300	0.7000	0.7700	157.1006	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	888.6807	1606.5920	2430.4254	3377.1470	4099.5020	4204.6718	3997.9831	3441.4671	2757.0852	1839.6273	1081.6904	749.1710	(83)
Total gains	2294.5677	3066.8195	3819.2420	4730.5494	5377.6140	5440.4262	5181.3508	4618.2837	3972.1991	3088.9425	2407.7508	2118.4973	(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	30.6056	30.6752	30.7437	31.0695	31.1312	31.4218	31.4218	31.4763	31.3093	31.1312	31.0066	30.8774	
alpha	3.0404	3.0450	3.0496	3.0713	3.0754	3.0948	3.0948	3.0984	3.0873	3.0754	3.0671	3.0585	
util living area													
	0.9968	0.9921	0.9810	0.9481	0.8761	0.7515	0.6177	0.6846	0.8765	0.9739	0.9940	0.9976	(86)
MIT	18.1613	18.4647	18.9575	19.6348	20.2513	20.6950	20.8823	20.8349	20.4480	19.6305	18.7783	18.1215	(87)
Th 2	20.0563	20.0583	20.0602	20.0691	20.0708	20.0786	20.0786	20.0800	20.0756	20.0708	20.0674	20.0639	(88)
util rest of house													
	0.9963	0.9907	0.9773	0.9373	0.8478	0.6896	0.5180	0.5899	0.8368	0.9668	0.9927	0.9971	(89)
MIT 2	17.4080	17.7120	18.2037	18.8781	19.4719	19.8770	20.0219	19.9940	19.6704	18.8818	18.0318	17.3732	(90)
Living area fraction										fLA = Living area / (4) =		0.0461	(91)
MIT	17.4427	17.7467	18.2384	18.9129	19.5078	19.9147	20.0616	20.0328	19.7062	18.9163	18.0662	17.4077	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4427	17.7467	18.2384	18.9129	19.5078	19.9147	20.0616	20.0328	19.7062	18.9163	18.0662	17.4077	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9938	0.9854	0.9672	0.9195	0.8269	0.6770	0.5160	0.5843	0.8168	0.9541	0.9883	0.9951	(94)
Useful gains	2280.3375	3021.9824	3693.9609	4349.8064	4446.5966	3683.3158	2673.6049	2698.5693	3244.4216	2947.1370	2379.6970	2108.1960	(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													
	11342.2293	11061.6179	10084.8529	8512.1970	6624.4572	4467.4776	2909.7518	3048.3828	4729.4893	7055.8535	9341.4822	11298.0073	(97)
Space heating kWh													
	6742.0475	5402.6351	4754.8236	2996.9212	1620.3283	0.0000	0.0000	0.0000	0.0000	3056.8851	5012.4854	6837.2196	(98a)
Space heating requirement - total per year (kWh/year)												36423.3457	
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													
	6742.0475	5402.6351	4754.8236	2996.9212	1620.3283	0.0000	0.0000	0.0000	0.0000	3056.8851	5012.4854	6837.2196	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												36423.3457	
Space heating per m2											(98c) / (4) =	43.5769	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	7901.5333	6220.3560	6377.4294	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6423	0.7211	0.6629	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	5075.2797	4485.2850	4227.7585	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	5975.5666	5689.0097	5061.4827	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	648.2066	895.5712	620.2908	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	162.0516	223.8928	155.0727	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												541.0172	(107)
Energy for space heating												43.5769	(99)
Energy for space cooling												0.6473	(108)
Total												44.2242	(109)
Fabric Energy Efficiency (TFEE)												44.2	(109)

Full SAP Calculation Printout

elmhurst energy

Property Reference	Proposed 63	Issued on Date	01/06/2023
Assessment Reference	Heatpump + PV	Prop Type Ref	63 SHELDON
Property	63, Sheldon Avenue, LONDON, N6 4NH		

SAP Rating	91 B	DER	1.55	TER	7.73
Environmental	98 A	% DER < TER			79.95
CO_2 Emissions (t/year)	1.16	DFEE	38.12	TFEE	44.22
Compliance Check	See BREL	% DFEE < TFEE			13.80
% DPER < TPER	62.60	DPER	15.62	TPER	41.76

Assessor Details	Mr. Mark Simons	Assessor ID	5542-0001
Client	EALConsult, Mark Simons		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	322.8800	(1a) x	2.9300	(2a) =	946.0384	(1a) -
Ground floor	235.0800	(1b) x	3.3700	(2b) =	792.2196	(1b) -
First floor	195.9200	(1c) x	3.3800	(2c) =	662.2096	(1c) -
Second floor	81.9600	(1d) x	3.3700	(2d) =	276.2052	(1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	835.8400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	2676.6728	(5)

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	10 * 10 =	100.0000	(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) =	100.0000 / (5) =	0.0374	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1874	(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) =	0.1874	(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	0.2389	0.2342	0.2295	0.2061	0.2014	0.1780	0.1780	0.1733	0.1874	0.2014	0.2108	0.2201	(22b)
Effective ac	0.5285	0.5274	0.5263	0.5212	0.5203	0.5158	0.5158	0.5150	0.5176	0.5203	0.5222	0.5242	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			103.2400	1.0536	108.7778			(27)
Entrance Door			3.5200	1.1000	3.8720			(26)
Rooflights			9.8400	1.0536	10.3678			(27a)
GF			4.1700	0.1000	0.4170	110.0000	458.7000	(28a)
BASEMENT			322.8800	0.1000	32.2880	110.0000	35516.8000	(28a)

EXTERNAL	483.0600	106.7600	376.3000	0.1400	52.6820	70.0000	26341.0000 (29a)
BASEMENT	217.2900		217.2900	0.1400	30.4206	70.0000	15210.3000 (29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885	9.0000	318.1500 (30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076	9.0000	352.4400 (30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756	9.0000	701.6400 (30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481	9.0000	609.3900 (30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1043	8.1963	9.0000	707.4900 (30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718	9.0000	1020.4200 (30)

Total net area of external elements Aum(A, m2) 1449.4100 (31)
Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 283.7131 (33)

Internal Floor GF	235.0800	18.0000	4231.4400 (32d)
Internal Floor FF	195.9200	18.0000	3526.5600 (32d)
Internal Floor SF	81.9600	18.0000	1475.2800 (32d)
Internal Ceiling LGF	235.0800	9.0000	2115.7200 (32e)
Internal Ceiling GF	195.9200	9.0000	1763.2800 (32e)
Internal Ceiling FF	81.9600	9.0000	737.6400 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 95086.2500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.3000	11.5590
E3 Sill	37.6400	0.0400	1.5056
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0700	6.2020
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0400	0.4832
E14 Flat roof	56.1400	0.0400	2.2456
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 47.3556 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 331.0687 (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	466.8540	465.8754	464.9161	460.4103	459.5673	455.6430	455.6430	454.9163	457.1546	459.5673	461.2727	463.0556	(38)
Heat transfer coeff	797.9227	796.9441	795.9848	791.4790	790.6360	786.7117	786.7117	785.9850	788.2233	790.6360	792.3414	794.1243	(39)

Average = Sum(39)m / 12 = 791.4750

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9546	0.9535	0.9523	0.9469	0.9459	0.9412	0.9412	0.9404	0.9430	0.9459	0.9480	0.9501	(40)
HLP (average)												0.9469	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

Hot water usage for mixer showers	88.4118	87.0832	85.1471	81.4426	78.7089	75.6602	73.9274	75.8488	77.9551	81.2284	85.0124	88.0731	(42a)
Hot water usage for baths	40.1507	39.5544	38.7147	37.1665	36.0071	34.7216	34.0273	34.8611	35.7690	37.1445	38.7247	40.0150	(42b)
Hot water usage for other uses	56.6715	54.6107	52.5499	50.4891	48.4283	46.3676	46.3676	48.4283	50.4891	52.5499	54.6107	56.6715	(42c)

Average daily hot water use (litres/day) 170.2583 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	185.2340	181.2483	176.4117	169.0982	163.1444	156.7494	154.3222	159.1383	164.2132	170.9229	178.3478	184.7595	(44)
Energy conte	293.3654	258.0952	271.1382	231.4870	219.6237	192.7417	186.6393	197.0464	202.4913	231.9407	254.0891	289.2888	(45)

Energy content (annual) Total = Sum(45)m = 2827.9468

Distribution loss (46)m = 0.15 x (45)m	44.0048	38.7143	40.6707	34.7231	32.9436	28.9113	27.9959	29.5570	30.3737	34.7911	38.1134	43.3933	(46)

Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.1000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1340 (55)

Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(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	351.7818	310.8584	329.5546	288.0190	278.0401	249.2737	245.0557	255.4628	259.0233	290.3571	310.6211	347.7052	(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	351.7818	310.8584	329.5546	288.0190	278.0401	249.2737	245.0557	255.4628	259.0233	290.3571	310.6211	347.7052	(64)

Total per year (kWh/year) = Sum(64)m = 3515.7528 (64)

12Total per year (kWh/year) 3516 (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

144.2771	128.0272	136.8866	122.1950	119.7580	109.3122	108.7907	112.2510	112.5540	123.8534	129.7102	142.9216	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	417.1479	461.8423	417.1479	431.0528	417.1479	431.0528	417.1479	417.1479	431.0528	417.1479	431.0528	417.1479	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	193.9209	190.5167	183.9873	169.7153	160.9650	151.8225	146.2240	150.8751	156.3249	166.4696	180.1531	192.0990	(72)
Total internal gains													
	1508.0887	1557.8526	1485.2755	1439.4496	1359.4108	1310.2407	1254.7071	1250.8845	1291.5927	1333.2912	1418.2632	1470.2366	(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	2.3800	11.2829	0.6300	1.0000	0.7700	11.7239	(75)
Southeast	47.5300	36.7938	0.6300	1.0000	0.7700	763.5133	(77)
Southwest	7.7700	36.7938	0.6300	1.0000	0.7700	124.8159	(79)
Northwest	45.5600	11.2829	0.6300	1.0000	0.7700	224.4294	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	1226.0255	2204.7471	3311.3531	4573.4281	5535.0650	5671.9172	5395.0592	4653.5975	3746.2081	2517.5693	1490.0371	1035.0948	(83)
Total gains	2734.1142	3762.5997	4796.6285	6012.8777	6894.4758	6982.1579	6649.7663	5904.4820	5037.8007	3850.8606	2908.3003	2505.3315	(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	33.1020	33.1427	33.1826	33.3715	33.4071	33.5737	33.5737	33.6048	33.5093	33.4071	33.3352	33.2603	
alpha	3.2068	3.2095	3.2122	3.2248	3.2271	3.2382	3.2382	3.2403	3.2340	3.2271	3.2223	3.2174	
util living area													
	0.9950	0.9861	0.9643	0.9035	0.7874	0.6281	0.4884	0.5570	0.7922	0.9521	0.9899	0.9963	(86)
Living	18.9925	19.2595	19.6565	20.1557	20.5568	20.7874	20.8663	20.8459	20.6429	20.0809	19.4349	18.9464	
Non living	17.7070	18.0487	18.5540	19.1806	19.6604	19.9154	19.9879	19.9740	19.7722	19.0988	18.2776	17.6506	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	0	0	0	0	0	0	0	0	0	0	14	
16 / 9	0	28	31	0	0	0	0	0	0	0	21	17	
MIT	21.0000	20.0142	20.2391	20.1557	20.5568	20.7874	20.8663	20.8459	20.6429	20.0809	19.9099	20.3622	(87)
Th 2	20.1213	20.1223	20.1233	20.1278	20.1286	20.1326	20.1326	20.1333	20.1311	20.1286	20.1269	20.1251	(88)
util rest of house													
	0.9942	0.9838	0.9581	0.8864	0.7503	0.5646	0.4031	0.4696	0.7412	0.9405	0.9878	0.9956	(89)
MIT 2	20.1213	19.2071	19.4306	19.1806	19.6604	19.9154	19.9879	19.9740	19.7722	19.0988	19.0007	19.5262	(90)
Living area fraction									fLA = Living area / (4) =			0.0461	(91)
MIT	20.1618	19.2442	19.4679	19.2255	19.7017	19.9556	20.0283	20.0142	19.8123	19.1440	19.0426	19.5647	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1618	19.2442	19.4679	19.2255	19.7017	19.9556	20.0283	20.0142	19.8123	19.1440	19.0426	19.5647	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9942	0.9809	0.9525	0.8648	0.7296	0.5506	0.3923	0.4567	0.7193	0.9227	0.9844	0.9951	(94)
Useful gains	2718.3492	3690.6201	4568.6080	5199.8585	5030.4468	3844.4274	2608.9182	2696.5322	3623.5971	3553.2471	2862.9995	2493.0990	(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													
	12656.4848	11431.5629	10322.2134	8172.4515	6326.4559	4213.3082	2697.1198	2840.6877	4502.5923	6755.2034	9462.6259	12201.4730	(97)
Space heating kWh													
	7393.9729	5201.9136	4280.6824	2140.2670	964.2308	0.0000	0.0000	0.0000	0.0000	2382.2555	4751.7310	7223.0303	(98a)
Space heating requirement - total per year (kWh/year)												34338.0835	
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													
	7393.9729	5201.9136	4280.6824	2140.2670	964.2308	0.0000	0.0000	0.0000	0.0000	2382.2555	4751.7310	7223.0303	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												34338.0835	
Space heating per m2											(98c) / (4) =	41.0821	(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 %)	437.7710	(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													
	7393.9729	5201.9136	4280.6824	2140.2670	964.2308	0.0000	0.0000	0.0000	0.0000	2382.2555	4751.7310	7223.0303	(98)
Space heating efficiency (main heating system 1)													
	437.7710	437.7710	437.7710	437.7710	437.7710	0.0000	0.0000	0.0000	0.0000	437.7710	437.7710	437.7710	(210)
Space heating fuel (main heating system)													
	1689.0048	1188.2728	977.8361	488.9011	220.2592	0.0000	0.0000	0.0000	0.0000	544.1785	1085.4377	1649.9564	(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													
	351.7818	310.8584	329.5546	288.0190	278.0401	249.2737	245.0557	255.4628	259.0233	290.3571	310.6211	347.7052	(64)
Efficiency of water heater												287.4489	(216)
(217)m	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	287.4489	(217)
Fuel for water heating, kWh/month													
	122.3806	108.1439	114.6481	100.1983	96.7268	86.7193	85.2519	88.8724	90.1111	101.0117	108.0613	120.9624	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	99.0824	79.4876	71.5698	52.4351	40.5024	33.0908	36.9476	48.0259	62.3809	81.8471	92.4461	101.8362	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-63.9842	-98.9769	-154.8647	-183.5401	-201.8275	-180.3111	-177.7296	-162.5663	-137.5333	-115.3818	-72.5954	-54.1835	(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	7843.8465	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	287.4489	
Water heating fuel used	1223.0878	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	799.6518	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1603.4946	(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	8263.0916	(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	7843.8465	0.1556	1220.8797	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1223.0878	0.1410	172.4768	(264)
Space and water heating			1393.3565	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	799.6518	0.1443	115.4145	(268)

Energy saving/generation technologies

PV Unit electricity used in dwelling	-1603.4946	0.1339	-214.6851
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-214.6851 (269)
Total CO2, kg/year			1294.0859 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.5500 (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	7843.8465	1.5762	12363.5818	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1223.0878	1.5214	1860.8515	(278)
Space and water heating			14224.4333	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	799.6518	1.5338	1226.5327	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1603.4946	1.4948	-2396.9020	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-2396.9020	(283)
Total Primary energy kWh/year			13054.0639	(286)
Dwelling Primary energy Rate (DPER)			15.6200	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	322.8800 (1a)	x	2.9300 (2a)	=	946.0384 (1a)	-
Ground floor	235.0800 (1b)	x	3.7100 (2b)	=	792.2196 (1b)	-
First floor	195.9200 (1c)	x	3.3800 (2c)	=	662.2096 (1c)	-
Second floor	81.9600 (1d)	x	3.3700 (2d)	=	276.2052 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 835.8400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		2676.6728	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0149	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2649	(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) =	0.2649	(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	0.3378	0.3312	0.3246	0.2914	0.2848	0.2517	0.2517	0.2451	0.2649	0.2848	0.2981	0.3113	(22b)
Effective ac	0.5571	0.5548	0.5527	0.5425	0.5406	0.5317	0.5317	0.5300	0.5351	0.5406	0.5444	0.5485	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			3.5200	1.0000	3.5200			(26)
TER Opening Type (Uw = 1.20)			103.2400	1.1450	118.2137			(27)
Rooflights			9.8400	2.0221	19.8971			(27a)
GF			4.1700	0.1300	0.5421			(28a)
BASEMENT			322.8800	0.1300	41.9744			(28a)
EXTERNAL	483.0600	106.7600	376.3000	0.1800	67.7340			(29a)
BASEMENT	217.2900		217.2900	0.1800	39.1122			(29a)
Flat Roof FF	35.3500		35.3500	0.1100	3.8885			(30)
Flat Roof GF	39.1600		39.1600	0.1100	4.3076			(30)
Flat Roof LGF #ROOFLIGHTS	87.8000	9.8400	77.9600	0.1100	8.5756			(30)
Flat Roof SF	67.7100		67.7100	0.1100	7.4481			(30)
Pitched Roof FF TO SF	78.6100		78.6100	0.1100	8.6471			(30)
Pitched Roof	113.3800		113.3800	0.1100	12.4718			(30)
Total net area of external elements Aum(A, m2)			1449.4100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	336.3322			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 113.7613 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	38.5300	0.0500	1.9265
E3 Sill	37.6400	0.0500	1.8820
E4 Jamb	102.0800	0.0500	5.1040
E22 Basement floor	72.3800	0.0700	5.0666
E6 Intermediate floor within a dwelling	88.6000	0.0000	0.0000
E24 Eaves (insulation at ceiling level - inverted)	29.2700	0.2400	7.0248
E11 Eaves (insulation at rafter level)	33.9000	0.0400	1.3560
E13 Gable (insulation at rafter level)	12.0800	0.0800	0.9664
E14 Flat roof	56.1400	0.0800	4.4912
E16 Corner (normal)	11.7200	0.0900	1.0548
E17 Corner (inverted – internal area greater than external area)	13.4800	-0.0900	-1.2132
E16 Corner (normal)	26.9600	0.0900	2.4264
E16 Corner (normal)	30.4200	0.0900	2.7378
E17 Corner (inverted – internal area greater than external area)	16.9000	-0.0900	-1.5210
R7 Flat ceiling (inverted)	8.7800	0.0400	0.3512
R8 Roof to wall (rafter)	36.5200	0.0600	2.1912
R9 Roof to wall (flat ceiling)	19.5400	0.0400	0.7816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 34.6263 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 370.9585 (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	492.0483	490.0914	488.1731	479.1632	477.4775	469.6302	469.6302	468.1769	472.6528	477.4775	480.8877	484.4529	(38)
Heat transfer coeff	863.0068	861.0499	859.1316	850.1217	848.4360	840.5887	840.5887	839.1354	843.6113	848.4360	851.8462	855.4114	(39)

Average = Sum(39)m / 12 = 850.1136

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0325	1.0302	1.0279	1.0171	1.0151	1.0057	1.0057	1.0039	1.0093	1.0151	1.0191	1.0234	(40)
HLP (average)												1.0171	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.8285 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	88.4118	87.0832	85.1471	81.4426	78.7089	75.6602	73.9274	75.8488	77.9551	81.2284	85.0124	88.0731	(42a)
Hot water usage for baths	38.1432	37.5767	36.7790	35.3081	34.2068	32.9855	32.3259	33.1180	33.9805	35.2873	36.7884	38.0142	(42b)
Hot water usage for other uses	53.8379	51.8802	49.9224	47.9647	46.0069	44.0492	44.0492	46.0069	47.9647	49.9224	51.8802	53.8379	(42c)

Average daily hot water use (litres/day) 165.8210 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	180.3929	176.5400	171.8485	164.7155	158.9226	152.6950	150.3024	154.9738	159.9003	166.4381	173.6810	179.9252	(44)
Energy conte	285.6983	251.3907	264.1247	225.4872	213.9404	187.7563	181.7778	191.8899	197.1731	225.8550	247.4404	281.7194	(45)
Energy content (annual)										Total = Sum(45)m =		2754.2531	
Distribution loss (46)m = 0.15 x (45)m	42.8547	37.7086	39.6187	33.8231	32.0911	28.1634	27.2667	28.7835	29.5760	33.8782	37.1161	42.2579	(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	344.3271	304.3457	322.7535	282.2248	272.5692	244.4938	240.4066	250.5187	253.9106	284.4838	304.1780	340.3482	(62)
WWHRS	-40.4182	-35.7462	-37.4313	-30.9946	-28.8859	-24.7179	-23.1690	-24.6380	-25.5740	-30.1490	-34.1551	-39.6697	(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													

	303.9089	268.5995	285.3221	251.2301	243.6833	219.7760	217.2375	225.8808	228.3366	254.3348	270.0229	300.6785	(64)
Total per year (kWh/year) = Sum(64)m =												3069.0111	(64)
12Total per year (kWh/year)												3069	(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													
	141.8977	125.9514	134.7245	120.3645	118.0382	107.8190	107.3442	110.7064	110.9501	121.9998	127.6640	140.5748	(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	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	191.4261	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	443.4680	490.9824	443.4680	458.2502	443.4680	458.2502	443.4680	443.4680	458.2502	443.4680	458.2502	443.4680	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	816.5922	825.0658	803.7125	758.2536	700.8701	646.9376	610.9074	602.4337	623.7871	669.2459	726.6295	780.5620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	42.1426	(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)													
	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	-153.1409	(71)
Water heating gains (Table 5)													
	190.7228	187.4277	181.0813	167.1730	158.6535	149.7486	144.2798	148.7990	154.0974	163.9783	177.3111	188.9446	(72)
Total internal gains													
	1534.2107	1586.9038	1511.6896	1467.1047	1386.4194	1335.3643	1279.0830	1275.1285	1316.5625	1360.1200	1445.6187	1496.4023	(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	2.3800	11.2829	0.6300	0.7000	0.7700	8.2067	(75)
Southeast	47.5300	36.7938	0.6300	0.7000	0.7700	534.4593	(77)
Southwest	7.7700	36.7938	0.6300	0.7000	0.7700	87.3711	(79)
Northwest	45.5600	11.2829	0.6300	0.7000	0.7700	157.1006	(81)
Horizontal	9.8400	26.0000	0.6300	0.7000	1.0000	101.5429	(82)

Solar gains	888.6807	1606.5920	2430.4254	3377.1470	4099.5020	4204.6718	3997.9831	3441.4671	2757.0852	1839.6273	1081.6904	749.1710	(83)
Total gains	2422.8914	3193.4958	3942.1150	4844.2517	5485.9214	5540.0361	5277.0660	4716.5956	4073.6477	3199.7473	2527.3090	2245.5733	(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	30.6056	30.6752	30.7437	31.0695	31.1312	31.4218	31.4218	31.4763	31.3093	31.1312	31.0066	30.8774	
alpha	3.0404	3.0450	3.0496	3.0713	3.0754	3.0948	3.0948	3.0984	3.0873	3.0754	3.0671	3.0585	
util living area													
	0.9963	0.9912	0.9793	0.9451	0.8710	0.7446	0.6099	0.6758	0.8701	0.9714	0.9931	0.9971	(86)
MIT	18.1909	18.4935	18.9842	19.6567	20.2672	20.7036	20.8865	20.8410	20.4629	19.6541	18.8057	18.1510	(87)
Th 2	20.0563	20.0583	20.0602	20.0691	20.0708	20.0786	20.0786	20.0800	20.0756	20.0708	20.0674	20.0639	(88)
util rest of house													
	0.9957	0.9896	0.9754	0.9337	0.8420	0.6821	0.5105	0.5808	0.8290	0.9637	0.9916	0.9966	(89)
MIT 2	16.6960	17.0842	17.7118	18.5677	19.3205	19.8281	20.0088	19.9744	19.5718	18.5745	17.4903	16.6491	(90)
Living area fraction										fLA = Living area / (4) =		0.0461	(91)
MIT	16.7648	17.1492	17.7704	18.6179	19.3641	19.8685	20.0492	20.0143	19.6129	18.6242	17.5509	16.7183	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.7648	17.1492	17.7704	18.6179	19.3641	19.8685	20.0492	20.0143	19.6129	18.6242	17.5509	16.7183	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9815	0.9607	0.9094	0.8146	0.6658	0.5070	0.5732	0.8029	0.9455	0.9849	0.9933	(94)
Useful gains	2402.6463	3134.4556	3787.1993	4405.4208	4468.6858	3688.3950	2675.3861	2703.3218	3270.5765	3025.3898	2489.0290	2230.6101	(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													
	10757.2410	10547.1325	9682.7758	8261.4059	6502.4775	4428.6125	2899.3909	3032.8844	4650.7386	6808.0456	8902.5699	10708.2830	(97)
Space heating kWh													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(98a)
Space heating requirement - total per year (kWh/year)												33612.3305	
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													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												33612.3305	

Space heating per m2 (98c) / (4) = 40.2138 (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													
	6215.8185	4981.3189	4386.3089	2776.3092	1513.1411	0.0000	0.0000	0.0000	0.0000	2814.2959	4617.7494	6307.3886	(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)													
	6734.3645	5396.8785	4752.2307	3007.9190	1639.3728	0.0000	0.0000	0.0000	0.0000	3049.0747	5002.9788	6833.5738	(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													
	303.9089	268.5995	285.3221	251.2301	243.6833	219.7760	217.2375	225.8808	228.3366	254.3348	270.0229	300.6785	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.3356	88.2905	88.1925	87.9766	87.4322	79.8000	79.8000	79.8000	79.8000	87.9776	88.2501	88.3466	(217)
Fuel for water heating, kWh/month													
	344.0390	304.2223	323.5220	285.5646	278.7110	275.4085	272.2275	283.0586	286.1361	289.0904	305.9744	340.3396	(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	92.1439	73.9212	66.5579	48.7632	37.6661	30.7735	34.3602	44.6628	58.0125	76.1155	85.9723	94.7048	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-236.8929	-305.5310	-401.6282	-410.9453	-410.5931	-370.9295	-365.0299	-358.9818	-346.0060	-327.0440	-249.4235	-208.1750	(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	-235.8670	-479.4048	-924.2432	-1349.4061	-1749.2625	-1746.3020	-1726.8735	-1478.7804	-1105.8513	-673.4567	-310.5655	-187.9600	(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	36416.3928	(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	3588.2938	(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)	743.6540	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-15959.1530	(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	24875.1876	(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	36416.3928	0.2100	7647.4425	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3588.2938	0.2100	753.5417	(264)
Space and water heating			8400.9842	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	743.6540	0.1443	107.3322	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3991.1800	0.1367	-545.4331	
PV Unit electricity exported	-11967.9730	0.1267	-1516.7747	
Total			-2062.2078	(269)
Total CO2, kg/year			6458.0379	(272)

EPC Target Carbon Dioxide Emission Rate (TER) 7.7300 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	36416.3928	1.1300	41150.5238	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3588.2938	1.1300	4054.7720	(278)
Space and water heating			45205.2959	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	743.6540	1.5338	1140.6413	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3991.1800	1.5052	-6007.4585	
PV Unit electricity exported	-11967.9730	0.4652	-5568.0282	
Total			-11575.4867	(283)
Total Primary energy kWh/year			34900.5512	(286)
Target Primary Energy Rate (TPER)			41.7600	(287)

APPENDIX 5

Project:	63 Sheldon
Plot:	Proposed

Total HTB Value	50.680
y Value = (HTB Value ÷ Total Exposed Area m2)	0.0350

63 Sheldon Road

	Ref	Junction Detail		Length	Value	Psi-A	Default	Approved
Junctions with an external wall	E1	(Perforated Lintel)		0	0.5	0.0000	1	0.5
	E2	(lintel)		38.53	0.3	11.5590	1	0.3
	E3	(Sill)		37.64	0.04	1.5056	0.08	0.04
	E4	(Jamb)		102.08	0.05	5.1040	0.1	0.05
	E5	Ground Floor (normal)		14.45	0.16	2.3120	0.32	0.16
	E5x	Ground Floor (corridor)		0	0.1248	0.0000		
	E19	Ground Floor (inverted)		0	0.07	0.0000	0.07	0.07
	E20	Exposed Floor (normal)		0	0.32	0.0000	0.32	0.32
	E21	Exposed Floor (inverted)		0	0.32	0.0000	0.32	0.32
	E22	Basement Floor		72.38	0.07	5.0666	0.07	0.07
	E6	(Intermediate floor within a dwelling)		88.6	0.07	6.2020	0.14	0.07
	E7	(Party floor between dwellings (in blocks of flats)		0	0.07	0.0000	0.14	0.07
	E8	(Balcony within a dwelling, wall insulation continuous)		0	0	0.0000	0	0
	E9	(Balcony between dwellings, wall insulation continuous)		0	0.02	0.0000	0.04	0.02
	E23	(Balcony within or between dwellings,balconly support penetr..)		0	1	0.0000	1	1
	E10	Eaves (insulation at ceiling level)		0	0.06	0.0000	0.12	0.06
	E24	Eaves (insulation at ceiling level - inverted)		29.27	0.24	7.0248	0.24	0.24
	E11	Eaves (insulation at rafter level)		33.9	0.04	1.3560	0.08	0.04
	E12	Gable (insulation at ceiling level)		0	0.24	0.0000	0.48	0.24
	E13	Gable (insulation at rafter level)		12.08	0.04	0.4832	0.08	0.04
	E14	Flat Roof		56.14	0.04	2.2456	0.08	0.04
	E15	Flat Roof with Parapet		0	0.28	0.0000	0.56	0.28
	BASEMENT			Storey height:		2.93		
			No. of junctions					
	E16	Corner (normal)	4	11.72	0.09	1.0548	0.18	0.09
	E17	Corner (inverted)	0	0	-0.09	0.0000	0	-0.09
	E18	Party Wall between dwellings	0	0	0.06	0.0000	0.12	0.06
	E25	Staggered party wall between dwellings	0	0	0.12	0.0000	0.12	0.12
	GROUND FLOOR			Storey height:		3.37		
			No. of junctions					
	E16	Corner (normal)	8	26.96	0.09	2.4264	0.18	0.09
	E17	Corner (inverted)	4	13.48	-0.09	-1.2132	0	-0.09
	E18	Party Wall between dwellings	0	0	0.06	0.0000	0.12	0.06
	E25	Staggered party wall between dwellings	0	0	0.12	0.0000	0.12	0.12
	FIRST FLOOR			Storey height:		3.38		
			No. of junctions					
	E16	Corner (normal)	9	30.42	0.09	2.7378	0.18	0.09
	E17	Corner (inverted)	5	16.9	-0.09	-1.5210	0	-0.09
	E18	Party Wall between dwellings	0	0	0.06	0.0000	0.12	0.06
	E25	Staggered party wall between dwellings	0	0	0.12	0.0000	0.12	0.12
	SECOND FLOOR			Storey height:		3.37		
			No. of junctions					
	E16	Corner (normal)	0	0	0.09	0.0000	0.18	0.09
	E17	Corner (inverted)	0	0	-0.09	0.0000	0	-0.09
	E18	Party Wall between dwellings	0	0	0.06	0.0000	0.12	0.06
	E25	Staggered party wall between dwellings	0	0	0.12	0.0000	0.12	0.12
	THIRD FLOOR			Storey height:				
			No. of junctions					
	E16	Corner (normal)		0	0.09	0.0000	0.18	0.09
	E17	Corner (inverted)		0	-0.09	0.0000	0	-0.09
	E18	Party Wall between dwellings		0	0.06	0.0000	0.12	0.06
	E25	Staggered party wall between dwellings		0	0.12	0.0000	0.12	0.12
	FOURTH FLOOR			Storey height:				
			No. of junctions					
	E16	Corner (normal)		0	0.09	0.0000	0.18	0.09
	E17	Corner (inverted)		0	-0.09	0.0000	0	-0.09
	E18	Party Wall between dwellings		0	0.06	0.0000	0.12	0.06
	E25	Staggered party wall between dwellings		0	0.12	0.0000	0.12	0.12
Junctions with a party wall	P1	Ground floor		0	0.16	0.0000	0.16	0.16
	P6	Ground floor (inverted)		0	0.18	0.0000	0.18	
	P2	Intermediate floor wthin a dwelling		0	0	0.0000	0	0
	P3	Intermediate floor between dwellings (in blocks of flats)		0	0	0.0000	0	0
	P7	Exposed floor (normal)		0	0.16	0.0000	0.16	0.16
	P8	Exposed floor (inverted)		0	0.24	0.0000	0.24	0.24
	P4	Roof (insulation at ceiling level)		0	0.12	0.0000	0.24	0.12
	P5	Roof (insulation at rafter level)		0	0.08	0.0000	0.08	0.08
Junctions within a roof or within a room in the roof	R1	Head		4.96	0.08	0.3968	0.08	0.08
	R2	Sill		4.96	0.06	0.2976	0.06	0.06
	R3	Jamb		3.98	0.08	0.3184	0.08	0.08
	R4	Ridge (vaulted ceiling)		0	0.08	0.0000	0.08	0.08
	R5	Ridge (inverted)		0	0.04	0.0000	0.04	0.04
	R6	Flat ceiling		0	0.06	0.0000	0.06	0.06
	R7	Flat Ceiling (inverted)		8.78	0.04	0.3512	0.04	0.04
	R8	Roof wall (rafter)		36.52	0.06	2.1912	0.06	0.06
	R9	Roof wall (flat ceiling)		19.54	0.04	0.7816	0.04	0.04

Openings

Windows Only

	width	height	sill	lintel	jamb	Area
W1	1.2	1.99	1.2	1.2	3.98	2.39
W2	1.2	1.99	1.2	1.2	3.98	2.39
W3	1.2	1.99	1.2	1.2	3.98	2.39
W4	1.2	1.99	1.2	1.2	3.98	2.39
W5	3.57	6.05	3.57	3.57	12.1	21.60
	1.2	1.99	1.2	1.2	3.98	2.39
W6	1.2	1.99	1.2	1.2	3.98	2.39
W7	1.2	1.99	1.2	1.2	3.98	2.39
W8	1.2	1.99	1.2	1.2	3.98	2.39
W9	1.69	2.5	1.69	1.69	5	4.23
W10	3.01	2.48	3.01	3.01	4.96	7.46
W11	1.99	2.48	1.99	1.99	4.96	4.94
W12	5.02	2.48	5.02	5.02	4.96	12.45
W13	1.19	1.6	1.19	1.19	3.2	1.90
W14	2	1.6	2	2	3.2	3.20
W15	1.19	1.6	1.19	1.19	3.2	1.90
W16	1.19	1.6	1.19	1.19	3.2	1.90
W17	2	1.6	2	2	3.2	3.20
W18	1.19	1.6	1.19	1.19	3.2	1.90
W19	0.8	1.5	0.8	0.8	3	1.20
W20	0.8	1.5	0.8	0.8	3	1.20
W21	0.8	1.5	0.8	0.8	3	1.20
W22	0.8	1.5	0.8	0.8	3	1.20
W23	0.8	1.5	0.8	0.8	3	1.20
W24			0	0	0	0.00
Total			37.64	37.64	98.02	89.7931 m2

Solid / Half Glazed / Full Glazed Doors

	width	height		lintel	jamb	Area
D1	0.89	2.03		0.89	4.06	1.81
D2				0	0	0.00
D3				0	0	0.00
D4				0	0	0.00
D5				0	0	0.00
D6				0	0	0.00
D7				0	0	0.00
D8				0	0	0.00
D9				0	0	0.00
D10				0	0	0.00
Total				0.89	4.06	1.8067 m2

Total			37.64	38.53	102.08	91.5998 m2

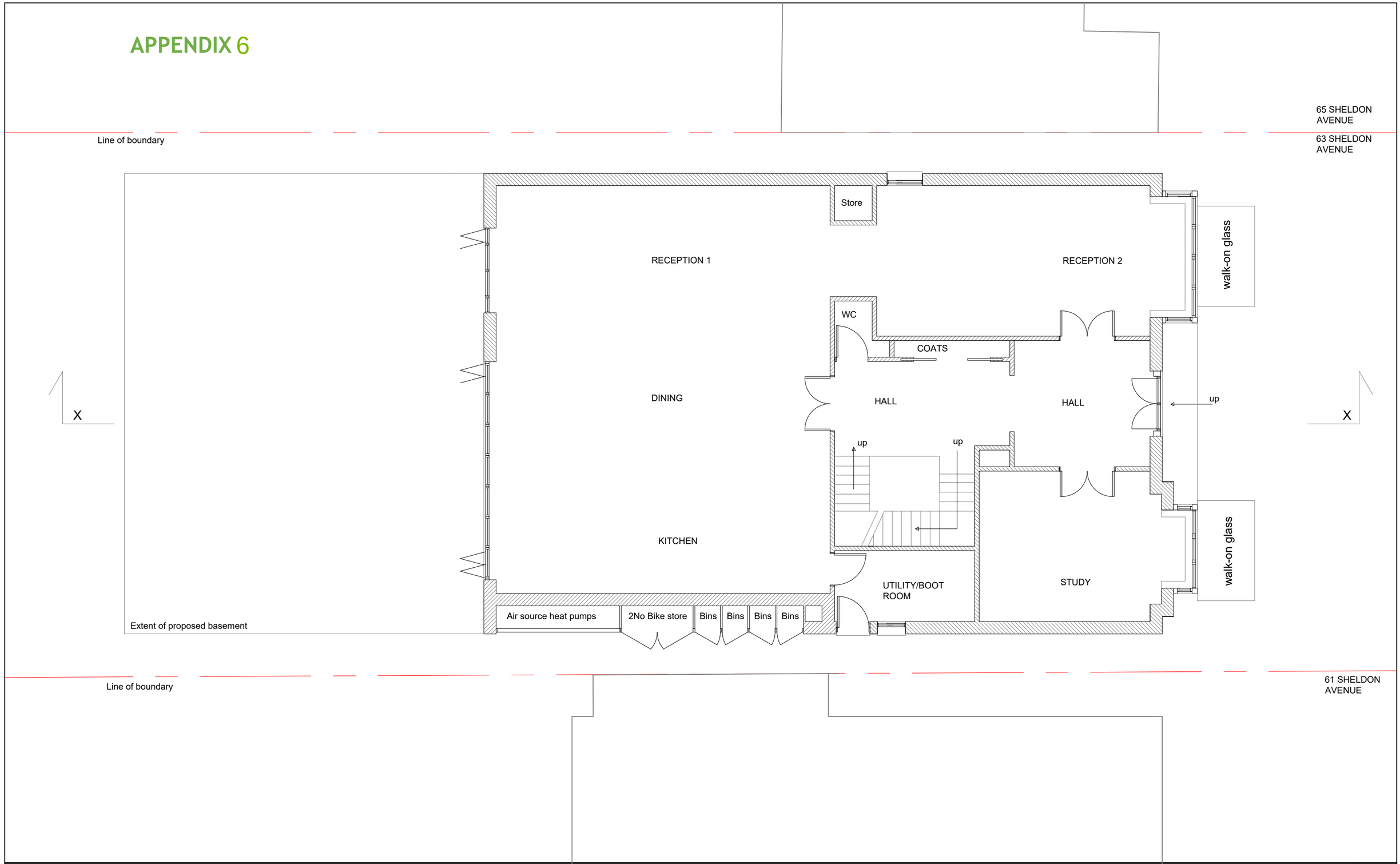
Rooflights

	width	height	sill	head	jamb	Area
R1	4.96	1.99	4.96	4.96	3.98	9.87
R2			0	0	0	0.00
R3			0	0	0	0.00
R4			0	0	0	0.00
R5			0	0	0	0.00
R6			0	0	0	0.00
R7			0	0	0	0.00
Total			4.96	4.96	3.98	9.87 m2

Areas

Exposed Element Areas (m2)	
Basement Floor Area	327.05
Exposed Floor Area	0.00
Total Exposed Floor Area	**327.05**
Basement Wall Area	217.29
Exposed Wall Area	483.06
Total Wall Area (Minus Openings)	**608.75**
Roof Area - Warm	78.61
Roof Area - Cold	113.38
Roof Area - Flat	230.02
Total Roof Area (Minus Openings)	**412.14**
Windows	89.79
Doors	1.81
Rooflights	9.87
Total Opening Area	**101.47**
Total Area (m2)	**1449.41**

APPENDIX 6



Site 63 Sheldon Avenue, London N6 4NH

Title Proposed Ground Floor

0m 5m

Drawing Number 167/016B

Date May 2022

Scale 1:100@A3

Status Planning

N

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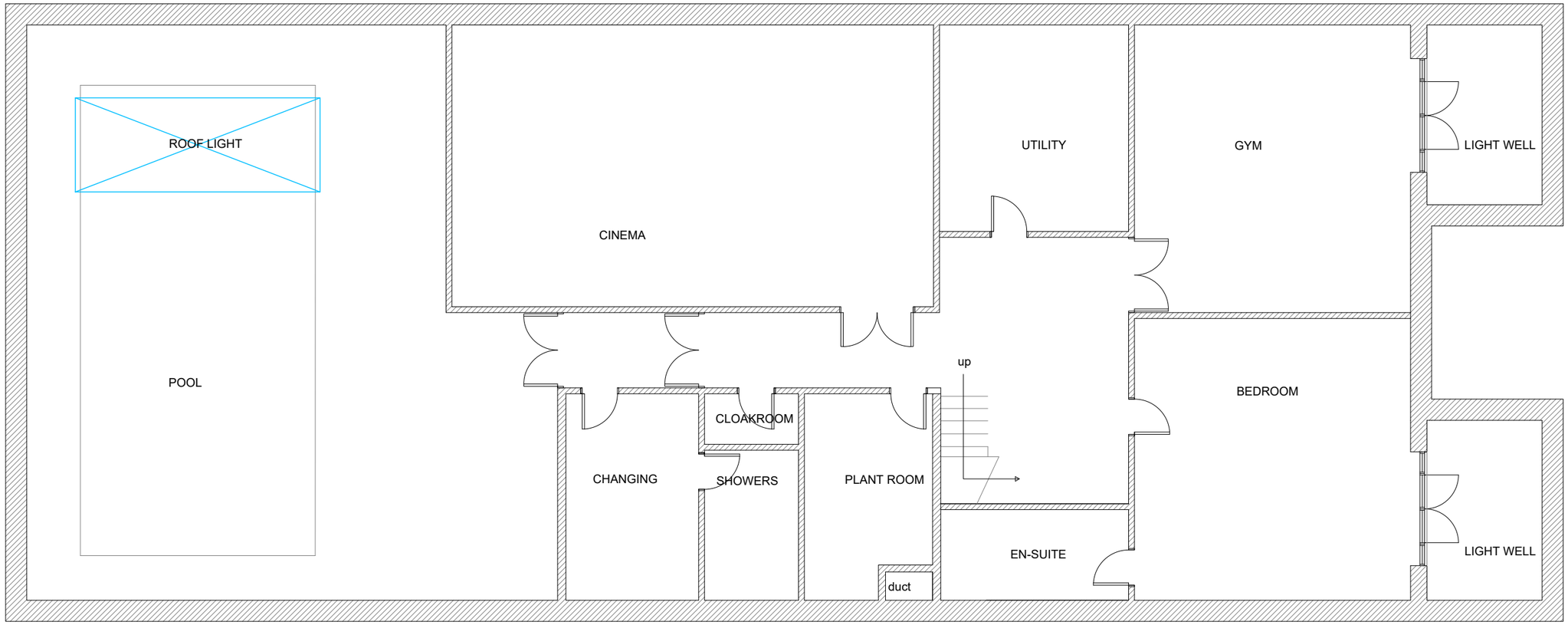
APPENDIX 7



Site 63 Sheldon Avenue, London N6 4NH

Title Proposed Lower Ground Floor

Drawing Number 167/015B

Date May 2022

Scale 1:100@A3

0m 5m

Status Planning

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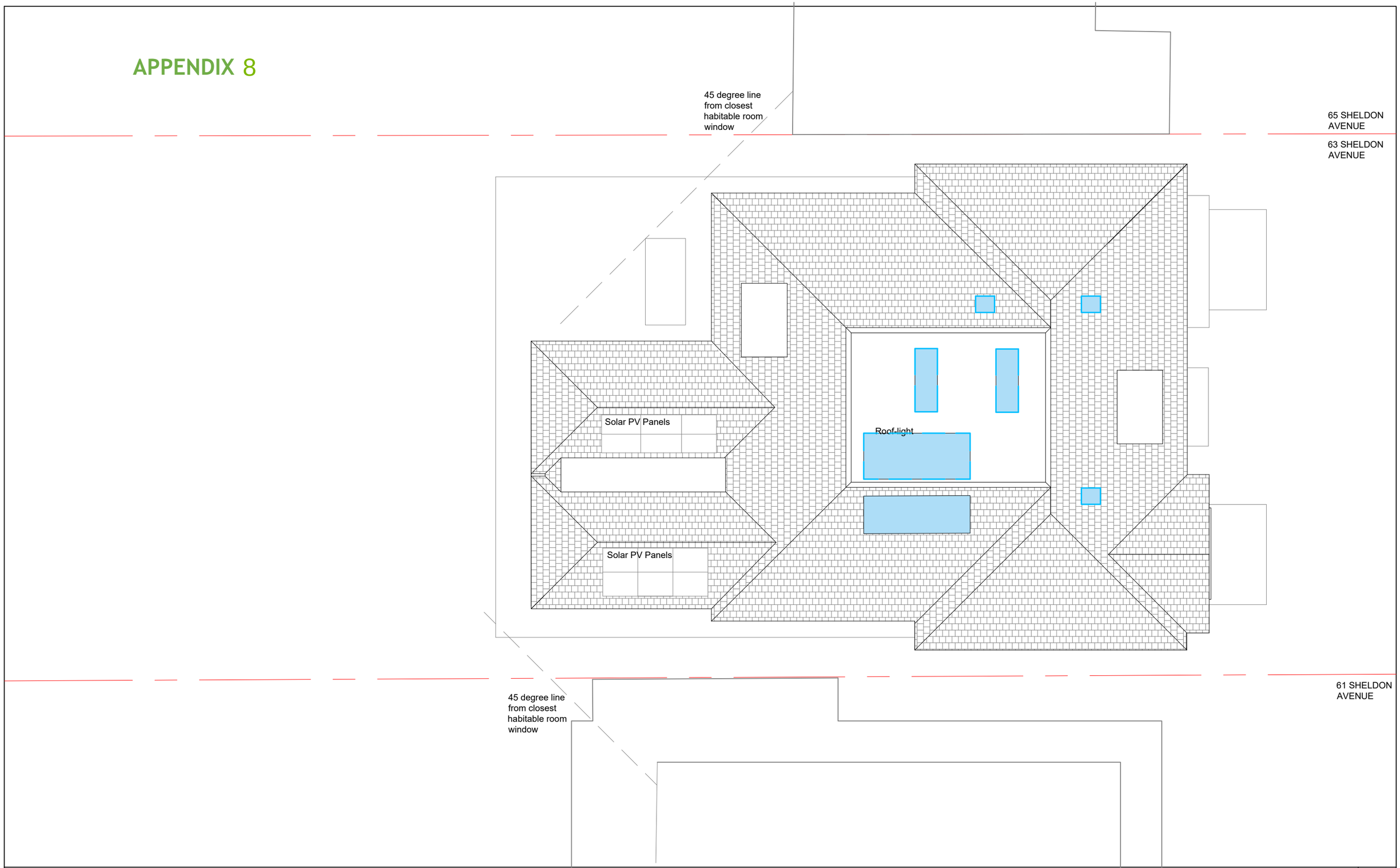

Site 63 Sheldon Avenue, London N6 4NH

Title Proposed Roof Plan

Drawing Number 167/019B

Date May 2022

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EARLY STAGE OVERHEATING RISK TOOL

APPENDIX 9

Version 1.0, July 2019

Good Homes Alliance

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes.

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	4	4
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	
#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	2
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	1	1

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	
	Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	1	1
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	1

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	3	
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance		1	1
#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	2	1
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space	>65%	12	4
	>50%	7	
	>35%	4	
#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation	Single-aspect	3	
	Dual aspect	0	

#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**

	Full	Part	
>65%	6	3	1
>50%	4	2	
>35%	2	1	

#14 Do windows & openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance

	Openings compared to Part F purge rates			
	= Part F	+50%	+100%	
Single-aspect	minimum required	3	4	3
Dual aspect		2	3	

TOTAL SCORE	1	= Sum of contributing factors:	10	*minus*	Sum of mitigating factors: 9

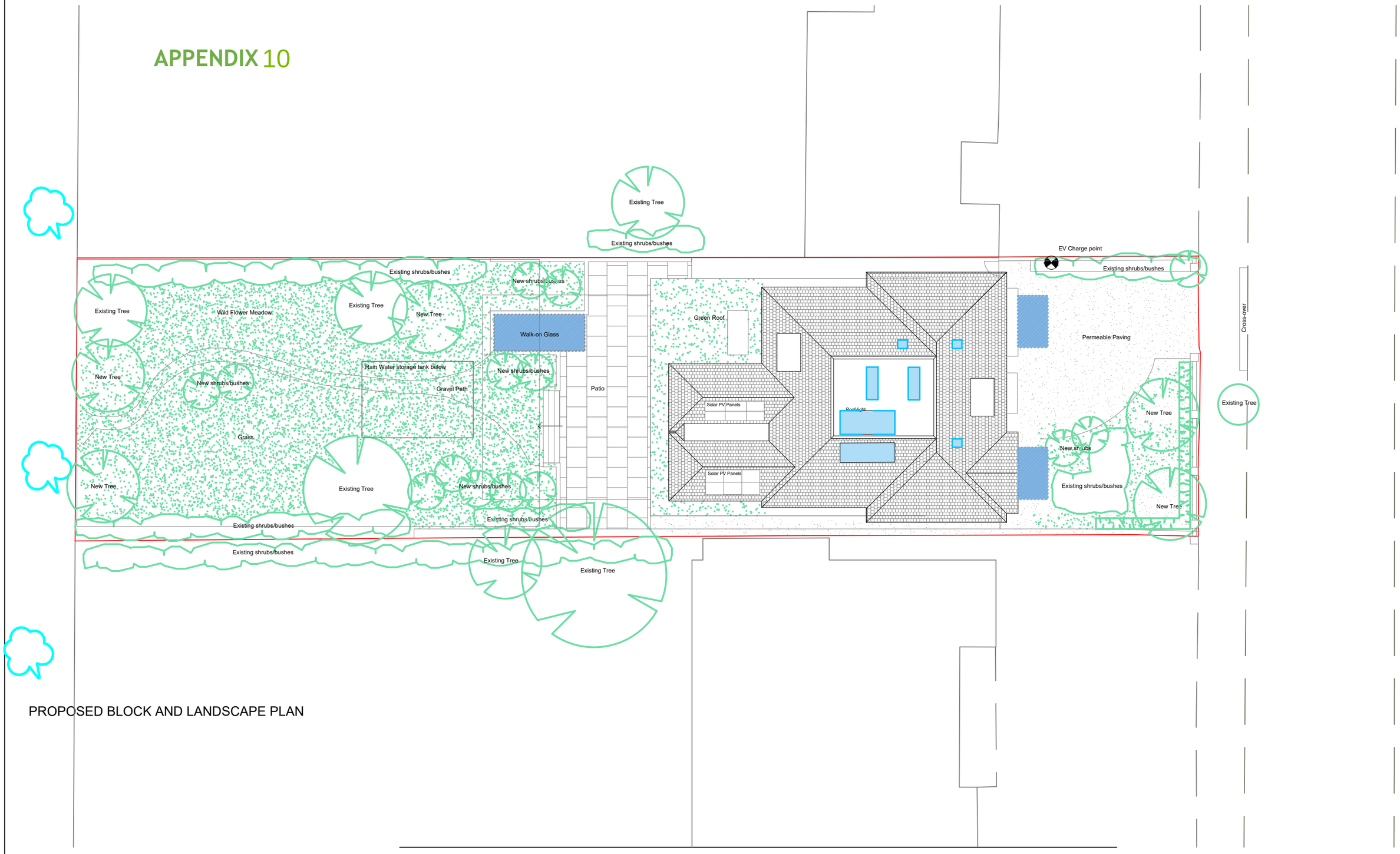
High 12 **Medium** 8 **Low**

score >12:
Incorporate design changes to reduce risk factors and increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score between 8 and 12:
Seek design changes to reduce risk factors and/or increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score <8:
Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)

APPENDIX 10



PROPOSED BLOCK AND LANDSCAPE PLAN

1 Drawing based on plans supplied by client and check dimensions

Site 63 Sheldon Avenue

Title Proposed Block and Landscape Plan

0m 5m

Drawing Number 167/005B

Date April 2022

Scale 1:200@A3

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