EAL CONSULT BUILDING SUSTAINABILITY SINCE 2008

ENERGY & SUSTAINABILITY ASSESSMENT

12 SPRING COURT ROAD

PROPERTY ADDRESS

12 SPRING COURT ROAD
ENFIELD
LONDON
EN2 8JP

DATE

March 2024

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 erection of four new build houses in Enfield.

Strategy

The strategy highlights how the proposed development will promote sustainability throughout both design and operation and responds to the UK Planning and regulatory framework, National Planning Policy Framework 2023, the London Plan 2021 and Enfield's Local Plan Strategic Policies, summarising how the relevant targets will be addressed and achieved.

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 **62%** reduction in carbon emissions over Part L 2021 baseline.
- ***Be 'Clean':*** district heating was deemed not viable for this project
- ***Be 'Green':*** Air Source Heat Pumps and Solar Photovoltaic Panels have been proposed for the specific scheme and will deliver a further **18%** reduction in regulated carbon emissions over Part L 2021 baseline

Energy Effcicency & Carbon Reduction

- This report demonstrates that the proposed development by incorporating the measures above can achieve an **overall** carbon emission reduction of **80%**

Overheating

The development proposal will minimise adverse impacts on the urban heat island through design, layout, orientation and materials.

Ventilation

The development utilises natural ventilation in the building.

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

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.

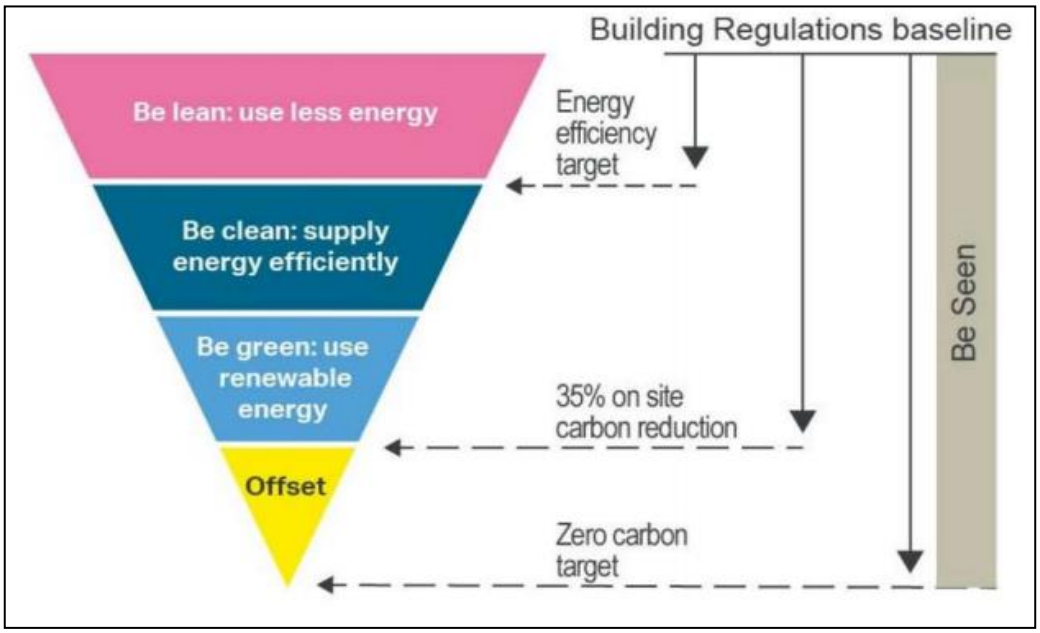
2. METHODOLOGY

This energy assessment outlines the energy demand from the development together with the associated CO_2 emissions, using Building Regulations Part L 2021 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) 2023

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.
- New updates emphasised that when determining planning applications, local planning authorities should give significant weight to the need to support energy efficiency and low carbon heating improvements to existing buildings, both domestic and non-domestic.

The London Plan 2021

Policy SI 2 Minimising Greenhouse Gas Emissions:

A. 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. 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.

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.

Enfield Draft Local Plan 2021

DRAFT STRATEGIC POLICY SP SE1 Responding to the climate emergency

The Council will work with partners to:

1. use all planning tools available to meet the 2040 net zero carbon borough commitments set out in the Climate Action Plan;
2. encourage innovative approaches to tackling climate change, reducing air pollution, managing flood risk and promoting sustainable infrastructure;
3. require high-quality and verifiable low energy development which maximises on-site renewable energy generation;
4. prioritise heat decarbonisation, with no new gas connections, ensuring all heating and hot water to be provided through low carbon sources;
5. ensure where appropriate development supports the expansion and decarbonisation of the Borough's heat network;
6. ensure development is designed for resilience in a changing climate, supporting future adaptability and mitigate the risk of overheating (including through considering the orientation of buildings and using trees for shading);
7. reduce flood risk (including through the use of Sustainable Drainage Systems), improve wastewater infrastructure in line with the Council's Infrastructure Delivery Plan;
8. require developments to embed design and operation that is aligned with sustainable waste management in operation, the minimisation of waste and the uplift of recycling targets; and
9. embed circular economy approach to building design and construction to reduce waste, support reuse and minimise embodied carbon, prioritising retrofit first.

DRAFT POLICY DM SE2 Sustainable design and construction

1. All development, including new developments, change of use, conversions and refurbishments, will be required to submit a sustainable design and construction statement. The statement should set out how sustainable design principles have been integrated into a design-led approach, including the consideration of the construction and operational phases of development. The statement should be proportionate to the nature and scale of development proposed with a sufficient level of detail to demonstrate that the relevant policy requirements have been satisfied.

DRAFT POLICY DM SE4 Reducing energy demand

1. All developments (resulting in the creation of one or more dwellings or 500 sq.m. or more non-residential gross internal area (GIA), including new build, change of use, conversions and major refurbishments) should deliver a high level of energy efficiency, in alignment with 'Be Lean' stage of the energy hierarchy and demonstrate a space heating demand, to meet the targets set out in Table 4.2:

Table 4.2: Space heating demand targets

	1st January 2023 (or Local Plan Adopted)	1st January 2025	1st January 2030
All developments	30 kWh/m2/yr	20 kWh/m2/yr	15 kWh/m2/yr

2. All developments (resulting in the creation of one or more dwellings or 500sqm or more non-residential GIA, including new build, change of use, conversions and major refurbishments) should meet the targets out set in Table 4.3:

Table 4.3: Operational energy use targets

	1st January 2023 (or Local Plan Adopted)	1st January 2025	1st January 2030
Domestic buildings	105 kWh/m^2/yr	70 kWh/m^2/yr	35 kWh/m^2/yr
Non-domestic buildings	170 kWh/m^2/yr	110 kWh/m^2/yr	55 kWh/m^2/yr

DRAFT POLICY DM SE5 Greenhouse gas emissions and low carbon energy supply

1. All developments (resulting in the creation of one or more dwellings or 500sqm or more non-residential GIA, including new build, change of use, conversions and major refurbishments) are required to:
    a. Provide an energy statement demonstrating how emissions savings have been maximised on site at each stage of the energy hierarchy.
    b. Achieve carbon reduction, as far as possible on-site meeting minimum reductions as set out in the table below, or London Plan/subsequent national policy, whichever is higher

Table 4.4: On-site carbon reduction targets

	Minimum on-site total reduction in CO2	Residual emissions carbon offset fund contribution
Major residential development of ten or more dwellings (including new build, change of use, conversions and major refurbishments)	Net-zero with minimum 45% on-site reduction	Tiered offset
Minor new build residential development of one or more dwellings	45% minimum on-site reduction with	£1,500 flat fee per dwelling
Minor residential change of use and conversions resulting in the creation of one or more dwellings	35% minimum on-site reduction	£1,000 flat fee per dwelling
Non-residential development of 500sqm GIA or more (including new build, change of use and major refurbishments)	Net-zero with minimum 45% on-site reduction	Tiered offset

4. ENERGY STRATEGY

The Energy strategy for the proposed development 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 average 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)	
	Regulated	**Unregulated**
Baseline: Part L 2021 of the Building Regulations Compliant Development	2.3	
After Energy Demand Reduction (Be Lean)	0.9	
After Heat Network Connection (Be Clean)	0.9	
After Renewables (Be Green)	0.5	

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

	Regulated Carbon dioxide savings	
	Tonnes CO_2 per annum	**%**
Be Lean: Savings from Energy Demand Reduction	1.4	62
Be Clean: Savings from Heat Network	0	0
Be Green: Savings from Renewable Energy	0.4	18
Cumulative on-site savings	1.8	80
Annual savings from off-set	0.5	
(Tonnes CO2)		
Cumulative savings for off-set payment	14	
Cash in-lieu contribution	1,323	

a. Baseline Model

In accordance with London Plan Policy SI 2, a baseline model is run assuming the development complied with Part L 2021 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 a heatpump and any active cooling would be provided by electrically powered equipment. The comparative Be 'Lean' model assumes the same heating strategy.

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 2021 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 **62%** 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 3. Energy Efficient Design Specification

Element	Building Regulations 2021 Standard	Specification
Wall	0.18 W/m²k	0.15 W/m²k
Roof	0.11 W/m²k	0.10 W/m²k
Floor	0.13 W/m²k	0.11 W/m²k
Windows, Doors and Rooflights	1.2 W/m²k	1.0 W/m²k

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

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement %
Development Total	39.94	36.40	9

Thermal Bridging - Thermal bridging will be reduced. The thermal bridging calculations achieve an average y-value of 0.062 aligning with enhanced construction detail and cold bridges will be avoided.

Air Permeability – designed to achieve an air permeability score of 3

Thermal Mass - The average thermal mass is 125 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 the built in cylinder.

Waste Water Heat Recovery – A Zypho PiPe 75 System A instantaneous system will be used

Energy Use Intensity and Space Heating Demand

Table 5. Energy Use Intensity (EUI) and Space Heating Demand

Building type	EUI	Space heating demand	EUI value from Table 4 of the guidance	Space heating demand from Table 4 of the guidance	Methodology used
	excluding renewable energy (kWh/m^2/year)				
Residential	1.4	8.25	35	15	SAP10.2

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.

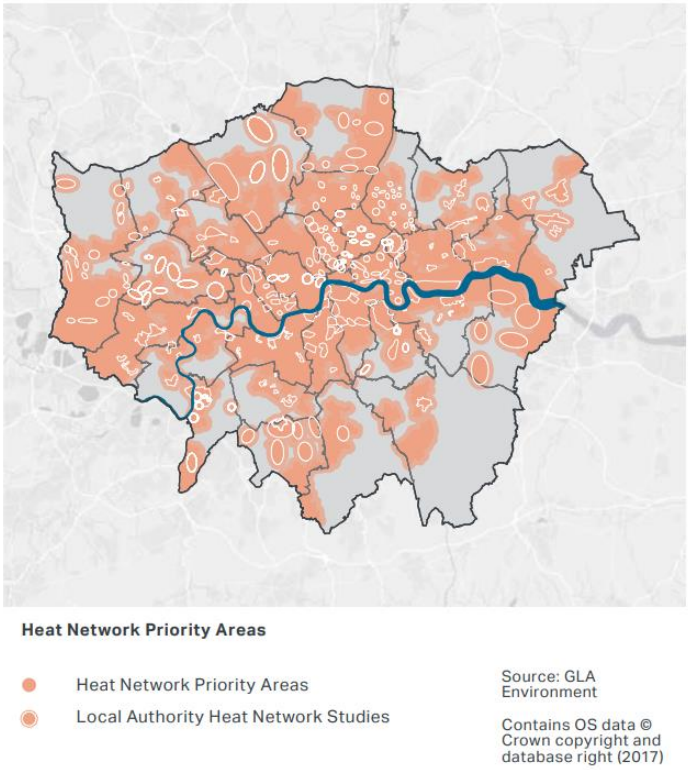
E. Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, 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 2 – 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.

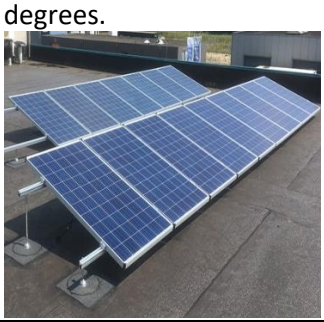
As the heating system proposed for this development is a heat pump, in accordance with the Air Quality Neutral LPG it is assumed that this project meets BEB and a full Air Quality Neutral (AQN) Assessment is not required.

d. Be 'Green' - Renewable Energy

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 6. 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.	

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).

On review of the above technologies, it has been concluded that the use of an air source heat pump and PV panels are to be incorporated in the design because it achieves a CO_2 percentage reduction of **18%** contributing to an overall reduction of **80%** in carbon emissions. Plans demonstrating the location of the ASHP and PV panels can be found in Appendix C and D.

Table 7. Photovoltaic Panels (per house)

System size	Orientatiom	Degree	Panels
1 kWp	South	30	4 (approx)
1 kWp	North	30	4 (approx)

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.

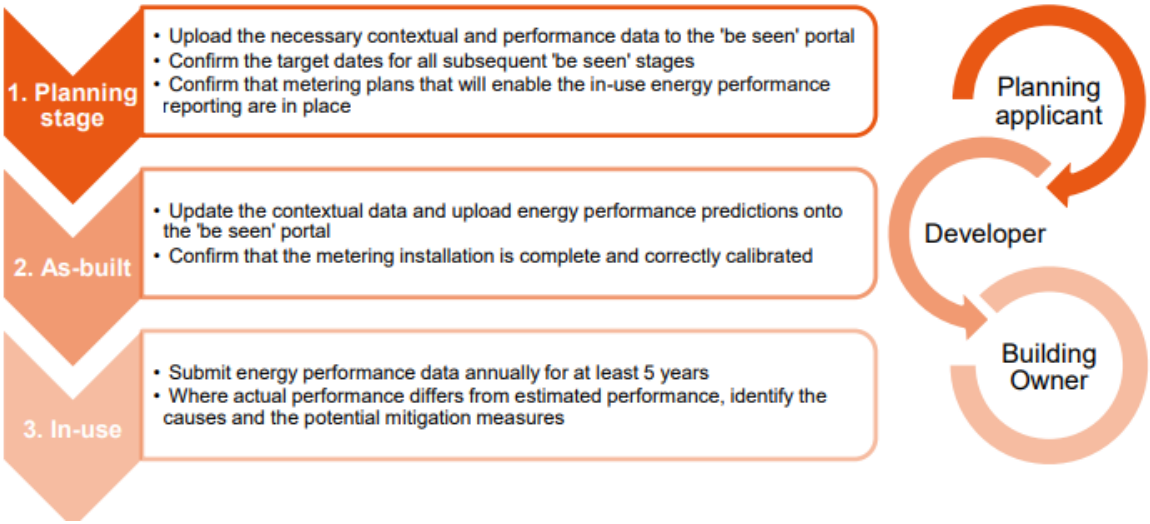
1.2.4 Ensuring that the actual energy and carbon performance of buildings is aligned with the estimated energy and carbon performance will also be a key factor in achieving a zero-carbon London.

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

Figure 3 'Be seen' process and responsibilities



As the houses achieve an EPC rating of B91, the operational running costs will be low due to the high performance. As the development includes renewable technologies it is less reliant on the main grid and will protect the consumer from high prices.

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

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

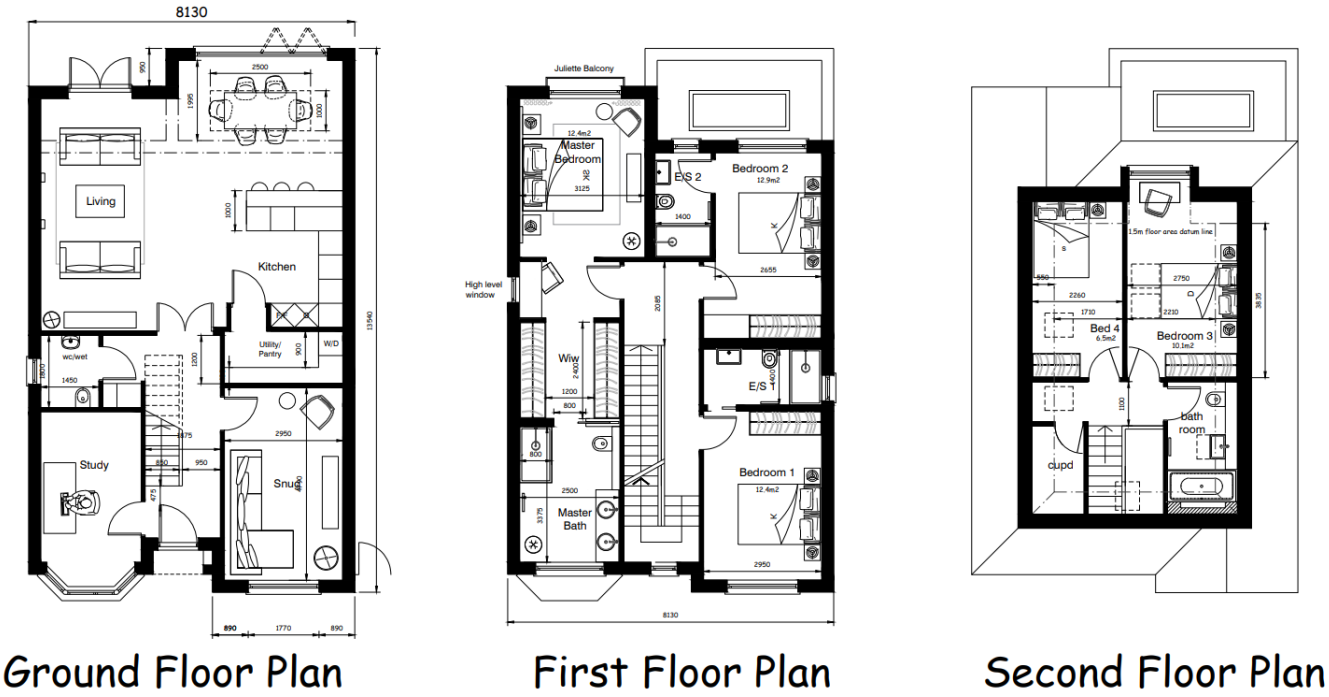
Minimise Heat Generation Through Energy Efficient Design

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, g-value of 0.63, higher air tightness and reduced cold bridging.

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 4. 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.

Resource efficiency

- Pre-demolition audit to be carried out and target benchmark of ≤ 11.1 tonnes of construction waste per 100m^2;

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

A space for reuse and recycling has been included at the ground floor unit for the residents exclusive use.

f. Flood Risk

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

g. 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%.

h. Biodiversity and Green Infrastructure

The proposed development can achieve an Urban Greening Factor score of 0.4 with the below measures

Table 9. Urban Greening Factor

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	90	90	
Wetland or open water (semi-natural; not chlorinated) maintained or established on site.	1		0	
Intensive green roof or vegetation over structure. Substrate minimum settled depth of 150mm.	0.8		0	
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	50	40	
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		0	
Flower-rich perennial planting.	0.7	200	140	
Rain gardens and other vegetated sustainable drainage elements.	0.7		0	
Hedges (line of mature shrubs one or two shrubs wide).	0.6	80	48	
Standard trees planted in pits with soil volumes less than two thirds of the projected canopy area of the mature tree.	0.6		0	
Green wall –modular system or climbers rooted in soil.	0.6		0	
Groundcover planting.	0.5	190	95	
Amenity grassland (species-poor, regularly mown lawn).	0.4	100	40	
Extensive green roof of sedum mat or other lightweight systems that do not meet GRO Code 2014.	0.3		0	
Water features (chlorinated) or unplanted detention basins.	0.2		0	
Permeable paving.	0.1	460	46	
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone).	0	300	0	
Total contribution			**499**	
Total site area (m²)			1391	
Urban Greening Factor			**0.4**	

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 **80%** from the notional emissions once energy efficiency measures and lean measures are taken into account.

The use of air source heat pumps and photovoltaic panels are to be incorporated in the design because they achieve a CO2 percentage reduction of **18%** contributing to the overall reduction of **80%** in carbon emissions. The remainder is made up from a fabric first approach with U-values outlined in the specification column of Table 3 on Page 10 of this report.

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

A. SAP Calculations

i. Baseline

Full SAP Calculation Printout

Property Reference	12 Spring Court	**Issued on Date**	07/03/2024
Assessment Reference	Option 1	**Prop Type Ref**	12 Spring Court
Property	12, Spring Court, ENFIELD, EN2 8JP		

SAP Rating	64 D	**DER**	6.56	**TER**	7.77
Environmental	92 A	**% DER < TER**			15.57
CO_2 Emissions (t/year)	1.71	**DFEE**	46.64	**TFEE**	39.94
Compliance Check	See BREL	**% DFEE < TFEE**			-16.80
% DPER < TPER	-64.20	**DPER**	67.40	**TPER**	41.05

Assessor Details	Mr. Mark Simons	**Assessor ID**	5542-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	127.1700 (1b)	x	2.6000 (2b)	=	330.6420	(1b) - (3b)
First floor	114.0400 (1c)	x	2.7500 (2c)	=	313.6100	(1c) - (3c)
Second floor	56.2900 (1d)	x	2.8500 (2d)	=	160.4265	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 297.5000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	804.6785	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0373	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2873	(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) =	0.2873	(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	0.3663	0.3591	0.3519	0.3160	0.3088	0.2729	0.2729	0.2657	0.2873	0.3088	0.3232	0.3376	(22b)
Effective ac	0.5671	0.5645	0.5619	0.5499	0.5477	0.5372	0.5372	0.5353	0.5413	0.5477	0.5522	0.5570	(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 = 1.00)			33.7600	0.9615	32.4615			(27)
ENTRANCE DOOR			2.4500	1.0000	2.4500			(26)
ROOFLIGHTS			3.4500	0.9615	3.3173			(27a)
ROOFLIGHTS			0.5900	0.9615	0.5673			(27a)
ROOFLIGHTS			1.1800	0.9615	1.1346			(27a)
ROOFLIGHTS			1.1800	0.9615	1.1346			(27a)
UNDERGROUND			127.1700	0.2200	27.9774	110.0000	13988.7000	(28a)
External Wall	260.9100	36.2100	224.7000	0.2800	62.9160	70.0000	15729.0000	(29a)
Roof Void	25.1200		25.1200	0.2500	6.2800	70.0000	1758.4000	(29a)
Flat Roof	34.7600	3.4500	31.3100	0.1800	5.6358	9.0000	281.7900	(30)
Pitched @Ceiling	57.7500		57.7500	0.1481	8.5556	9.0000	519.7500	(30)
Pitched @Rafter	37.6600	2.9500	34.7100	0.1600	5.5536	9.0000	312.3900	(30)
Total net area of external elements Aum(A, m2)			543.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		157.9837			(33)
FF			114.0400			18.0000	2052.7200	(32d)
SF			56.2900			18.0000	1013.2200	(32d)
GF			114.0400			9.0000	1026.3600	(32e)
FF			56.2900			9.0000	506.6100	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 37188.9400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 125.0048 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.6300	0.3000	6.4890
E3 Sill	15.6400	0.0400	0.6256
E4 Jamb	47.1400	0.0500	2.3570
E5 Ground floor (normal)	50.2800	0.1600	8.0448
E20 Exposed floor (normal)	2.4400	0.3200	0.7808
E6 Intermediate floor within a dwelling	43.4900	0.0700	3.0443
E10 Eaves (insulation at ceiling level)	33.5800	0.0600	2.0148
E12 Gable (insulation at ceiling level)	12.3600	0.2400	2.9664
E14 Flat roof	11.0200	0.0400	0.4408
E16 Corner (normal)	23.4000	0.0900	2.1060
E17 Corner (inverted - internal area greater than external area)	7.8000	-0.0900	-0.7020
E16 Corner (normal)	16.5000	0.0900	1.4850
E17 Corner (inverted - internal area greater than external area)	5.5000	-0.0900	-0.4950
R1 Head of roof window	7.0900	0.0800	0.5672
R2 Sill of roof window	5.8450	0.0600	0.3507
R3 Jamb of roof window	9.3400	0.0800	0.7472
R1 Head of roof window	1.8000	0.0400	0.0720
R8 Roof to wall (rafter)	28.5500	0.0600	1.7130
R9 Roof to wall (flat ceiling)	22.2400	0.0400	0.8896

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 33.4972 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 191.4809 (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	150.5852	149.8935	149.2155	146.0309	145.4351	142.6614	142.6614	142.1477	143.7297	145.4351	146.6404	147.9006	(38)
Heat transfer coeff	342.0662	341.3744	340.6964	337.5118	336.9160	334.1423	334.1423	333.6287	335.2107	336.9160	338.1213	339.3815	(39)
Average = Sum(39)m / 12 =												337.5090	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1498	1.1475	1.1452	1.1345	1.1325	1.1232	1.1232	1.1214	1.1268	1.1325	1.1365	1.1408	(40)
HLP (average)												1.1345	
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 3.1287 (42)

Hot water usage for mixer showers	76.6776	75.5253	73.8461	70.6334	68.2624	65.6184	64.1155	65.7820	67.6087	70.4476	73.7293	76.3838 (42a)
Hot water usage for baths	34.8390	34.3216	33.5930	32.2496	31.2436	30.1282	29.5257	30.2492	31.0370	32.2305	33.6016	34.7213 (42b)
Hot water usage for other uses	49.1272	47.3407	45.5543	43.7678	41.9814	40.1950	40.1950	41.9814	43.7678	45.5543	47.3407	49.1272 (42c)
Average daily hot water use (litres/day)												147.6565 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	160.6438	157.1876	152.9934	146.6508	141.4874	135.9415	133.8361	138.0126	142.4135	148.2324	154.6717	160.2322	(44)
Energy conte	254.4205	223.8331	235.1452	200.7576	190.4693	167.1560	161.8632	170.8884	175.6101	201.1500	220.3582	250.8849	(45)
Energy content (annual)										Total = Sum(45)m =		2452.5364	
Distribution loss (46)m = 0.15 x (45)m	38.1631	33.5750	35.2718	30.1136	28.5704	25.0734	24.2795	25.6333	26.3415	30.1725	33.0537	37.6327	(46)
Water storage loss:													
Store volume												175.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0800	(55)
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(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	311.1629	275.0843	291.8876	255.6696	247.2117	222.0680	218.6056	227.6308	230.5221	257.8924	275.2702	307.6273	(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	311.1629	275.0843	291.8876	255.6696	247.2117	222.0680	218.6056	227.6308	230.5221	257.8924	275.2702	307.6273	(64)
									Total per year (kWh/year) = Sum(64)m =			3120.6324	(64)
12Total per year (kWh/year)												3121	(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	129.9887	115.4255	123.5797	110.6815	108.7250	99.5090	99.2134	102.2143	102.3200	112.2763	117.1987	128.8132	(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	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	247.1073	273.5831	247.1073	255.3442	247.1073	255.3442	247.1073	247.1073	255.3442	247.1073	255.3442	247.1073	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.2370	460.9713	449.0410	423.6427	391.5820	361.4495	341.3191	336.5848	348.5151	373.9134	405.9740	436.1066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	(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)	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	(71)
Water heating gains (Table 5)	174.7160	171.7641	166.1017	153.7243	146.1357	138.2069	133.3514	137.3848	142.1111	150.9090	162.7760	173.1360	(72)
Total internal gains	947.9905	976.2487	932.1802	902.6415	854.7553	824.9308	791.7080	791.0072	815.9006	841.8599	894.0245	926.2801	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8600	10.6334	0.6300	0.7000	0.7700	2.7947	(74)
East	12.0500	19.6403	0.6300	0.7000	0.7700	72.3280	(76)
South	1.7200	46.7521	0.6300	0.7000	0.7700	24.5754	(78)
West	19.1300	19.6403	0.6300	0.7000	0.7700	114.8244	(80)
North	1.1800	16.7973	0.6300	0.7000	1.0000	7.8669	(82)
East	0.5900	26.6072	0.6300	0.7000	1.0000	6.2306	(82)
South	1.1800	42.0754	0.6300	0.7000	1.0000	19.7057	(82)
Horizontal	3.4500	26.0000	0.6300	0.7000	1.0000	35.6019	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	283.9276	549.7170	900.2048	1318.6884	1630.1140	1676.9840	1593.0199	1357.4521	1047.6379	650.1283	352.7801	234.4044	(83)
Total gains	1231.9181	1525.9657	1832.3850	2221.3299	2484.8693	2501.9148	2384.7280	2148.4593	1863.5385	1491.9882	1246.8046	1160.6845	(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	30.1996	30.2608	30.3210	30.6071	30.6612	30.9158	30.9158	30.9634	30.8172	30.6612	30.5519	30.4385	
alpha	3.0133	3.0174	3.0214	3.0405	3.0441	3.0611	3.0611	3.0642	3.0545	3.0441	3.0368	3.0292	
util living area	0.9923	0.9848	0.9680	0.9217	0.8321	0.6918	0.5540	0.6166	0.8279	0.9559	0.9869	0.9936	(86)
Living	18.8915	19.1123	19.4813	19.9847	20.4203	20.7160	20.8324	20.8052	20.5528	19.9657	19.3421	18.8604	
Non living	17.4576	17.7408	18.2112	18.8482	19.3755	19.7091	19.8165	19.7986	19.5449	18.8357	18.0419	17.4228	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	0	0	0	0	0	8	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	23	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	20.4203	20.7160	20.8324	20.8052	20.5528	20.5654	21.0000	21.0000	(87)
Th 2	19.9604	19.9622	19.9641	19.9728	19.9744	19.9820	19.9820	19.9834	19.9790	19.9744	19.9711	19.9677	(88)
util rest of house	0.9908	0.9819	0.9615	0.9050	0.7942	0.6192	0.4472	0.5113	0.7740	0.9435	0.9839	0.9923	(89)
MIT 2	19.9604	19.9622	19.9641	19.9728	19.3755	19.7091	19.8165	19.7986	19.5449	19.6015	19.9711	19.9677	(90)
Living area fraction										fLA = Living area / (4) =		0.0657	(91)
MIT	20.0287	20.0304	20.0322	20.0403	19.4441	19.7753	19.8832	19.8648	19.6111	19.6648	20.0387	20.0355	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.0287	20.0304	20.0322	20.0403	19.4441	19.7753	19.8832	19.8648	19.6111	19.6648	20.0387	20.0355	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9909	0.9821	0.9620	0.9062	0.7708	0.6025	0.4359	0.4976	0.7501	0.9388	0.9841	0.9924	(94)
Useful gains	1220.7072	1498.6195	1762.7164	2013.0016	1915.2717	1507.3470	1039.6084	1069.0244	1397.7874	1400.7486	1226.9758	1151.9008	(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	5380.2514	5165.1467	4610.3606	3759.9718	2609.1248	1729.2703	1097.0665	1155.9524	1847.3919	3054.0857	4374.8558	5374.2786	(97)
Space heating kWh	3094.7009	2463.9062	2118.6473	1257.8185	516.2268	0.0000	0.0000	0.0000	0.0000	1230.0828	2266.4736	3141.4491	(98a)
Space heating requirement - total per year (kWh/year)												16089.3052	
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	3094.7009	2463.9062	2118.6473	1257.8185	516.2268	0.0000	0.0000	0.0000	0.0000	1230.0828	2266.4736	3141.4491	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												16089.3052	
Space heating per m2											(98c) / (4) =	54.0817	(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 %)	158.6645 (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	3094.7009	2463.9062	2118.6473	1257.8185	516.2268	0.0000	0.0000	0.0000	0.0000	1230.0828	2266.4736	3141.4491	(98)
Space heating efficiency (main heating system 1)	158.6645	158.6645	158.6645	158.6645	158.6645	0.0000	0.0000	0.0000	0.0000	158.6645	158.6645	158.6645	(210)
Space heating fuel (main heating system)	1950.4686	1552.9034	1335.3003	792.7537	325.3575	0.0000	0.0000	0.0000	0.0000	775.2729	1428.4694	1979.9321	(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	311.1629	275.0843	291.8876	255.6696	247.2117	222.0680	218.6056	227.6308	230.5221	257.8924	275.2702	307.6273	(64)
Efficiency of water heater												137.6693	(216)
(217)m	137.6693	137.6693	137.6693	137.6693	137.6693	137.6693	137.6693	137.6693	137.6693	137.6693	137.6693	137.6693	(217)
Fuel for water heating, kWh/month	226.0219	199.8152	212.0208	185.7128	179.5692	161.3053	158.7904	165.3460	167.4462	187.3274	199.9503	223.4538	(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	52.3659	42.0099	37.8252	27.7124	21.4058	17.4888	19.5271	25.3821	32.9688	43.2569	48.8585	53.8213	(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	10140.4578	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	137.6693	
Water heating fuel used	2266.7595	(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)	422.6227	(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	12829.8399	(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	10140.4578	0.1549	1570.8677	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2266.7595	0.1410	319.5328	(264)
Space and water heating			1890.4006	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	422.6227	0.1443	60.9975	(268)
Total CO2, kg/year			1951.3981	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			6.5600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	10140.4578	1.5735	15956.2731	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2266.7595	1.5212	3448.2833	(278)
Space and water heating			19404.5563	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	422.6227	1.5338	648.2328	(282)
Total Primary energy kWh/year			20052.7891	(286)
Dwelling Primary energy Rate (DPER)			67.4000	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	127.1700 (1b)	x	2.6000 (2b)	=	330.6420	(1b) - (3b)
First floor	114.0400 (1c)	x	2.7500 (2c)	=	313.6100	(1c) - (3c)
Second floor	56.2900 (1d)	x	2.8500 (2d)	=	160.4265	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	297.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	804.6785	(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) =	0.0497	(8)

Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.2997	(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) = 0.2997	(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	0.3821	0.3746	0.3671	0.3297	0.3222	0.2847	0.2847	0.2772	0.2997	0.3222	0.3372	0.3522	(22b)
Effective ac	0.5730	0.5702	0.5674	0.5543	0.5519	0.5405	0.5405	0.5384	0.5449	0.5519	0.5568	0.5620	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.4500	1.0000	2.4500			(26)
TER Opening Type (Uw = 1.20)			33.7600	1.1450	38.6565			(27)
ROOFLIGHTS			3.4500	1.5918	5.4916			(27a)
ROOFLIGHTS			0.5900	1.5918	0.9391			(27a)
ROOFLIGHTS			1.1800	1.5918	1.8783			(27a)
ROOFLIGHTS			1.1800	1.5918	1.8783			(27a)
UNDERGROUND			127.1700	0.1300	16.5321			(28a)
External Wall	260.9100	36.2100	224.7000	0.1800	40.4460			(29a)
Roof Void	25.1200		25.1200	0.1800	4.5216			(29a)
Flat Roof	34.7600	3.4500	31.3100	0.1100	3.4441			(30)
Pitched @Ceiling	57.7500		57.7500	0.1100	6.3525			(30)
Pitched @Rafter	37.6600	2.9500	34.7100	0.1100	3.8181			(30)
Total net area of external elements Aum(A, m2)			543.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		126.4082			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	125.0048	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.6300	0.0500	1.0815
E3 Sill	15.6400	0.0500	0.7820
E4 Jamb	47.1400	0.0500	2.3570
E5 Ground floor (normal)	50.2800	0.1600	8.0448
E20 Exposed floor (normal)	2.4400	0.3200	0.7808
E6 Intermediate floor within a dwelling	43.4900	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	33.5800	0.0600	2.0148
E12 Gable (insulation at ceiling level)	12.3600	0.0600	0.7416
E14 Flat roof	11.0200	0.0800	0.8816
E16 Corner (normal)	23.4000	0.0900	2.1060
E17 Corner (inverted - internal area greater than external area)	7.8000	-0.0900	-0.7020
E16 Corner (normal)	16.5000	0.0900	1.4850
E17 Corner (inverted - internal area greater than external area)	5.5000	-0.0900	-0.4950
R1 Head of roof window	7.0900	0.0800	0.5672
R2 Sill of roof window	5.8450	0.0600	0.3507
R3 Jamb of roof window	9.3400	0.0800	0.7472
R1 Head of roof window	1.8000	0.0800	0.1440
R8 Roof to wall (rafter)	28.5500	0.0600	1.7130
R9 Roof to wall (flat ceiling)	22.2400	0.0400	0.8896

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	23.4898	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	149.8980	(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	152.1597	151.4068	150.6689	147.2028	146.5543	143.5355	143.5355	142.9764	144.6983	146.5543	147.8662	149.2377	(38)
Heat transfer coeff	302.0576	301.3048	300.5669	297.1008	296.4523	293.4334	293.4334	292.8744	294.5962	296.4523	297.7642	299.1357	(39)
Average = Sum(39)m / 12 =												297.0977	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0153	1.0128	1.0103	0.9987	0.9965	0.9863	0.9863	0.9845	0.9902	0.9965	1.0009	1.0055	(40)
HLP (average)												0.9986	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.1287	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
76.6776	75.5253	73.8461	70.6334	68.2624	65.6184	64.1155	65.7820	67.6087	70.4476	73.7293	76.3838	(42a)

Hot water usage for baths

33.0971	32.6055	31.9134	30.6371	29.6814	28.6218	28.0494	28.7367	29.4851	30.6190	31.9216	32.9852	(42b)

Hot water usage for other uses

46.6708	44.9737	43.2766	41.5795	39.8823	38.1852	38.1852	39.8823	41.5795	43.2766	44.9737	46.6708	(42c)
Average daily hot water use (litres/day)												143.8084	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	156.4455	153.1045	149.0360	142.8499	137.8262	132.4254	130.3501	134.4010	138.6733	144.3432	150.6246	156.0398	(44)
Energy conte	247.7714	218.0188	229.0628	195.5544	185.5406	162.8324	157.6472	166.4165	170.9980	195.8723	214.5924	244.3206	(45)
Energy content (annual)										Total = Sum(45)m =		2388.6274	

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

37.1657	32.7028	34.3594	29.3332	27.8311	24.4249	23.6471	24.9625	25.6497	29.3808	32.1889	36.6481	(46)
Water storage loss:												
Store volume												175.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5263	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8242	(55)
Total storage loss													
25.5498	23.0773	25.5498	24.7257	25.5498	24.7257	25.5498	25.5498	24.7257	25.5498	24.7257	25.5498	(56)
If cylinder contains dedicated solar storage												
25.5498	23.0773	25.5498	24.7257	25.5498	24.7257	25.5498	25.5498	24.7257	25.5498	24.7257	25.5498	(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													

	296.5836	262.1073	277.8751	242.7920	234.3528	210.0701	206.4594	215.2288	218.2357	244.6846	261.8300	293.1329	(62)
WWHRS	-35.0538	-31.0019	-32.4634	-26.8809	-25.0521	-21.4372	-20.0940	-21.3679	-22.1798	-26.1475	-29.6220	-34.4046	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	261.5299	231.1054	245.4117	215.9111	209.3007	188.6329	186.3654	193.8608	196.0559	218.5370	232.2080	258.7282	(64)
										Total per year (kWh/year) = Sum(64)m =		2637.6471	(64)
12Total per year (kWh/year)												2638	(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													
	121.4338	107.7620	115.2132	102.8120	100.7420	91.9319	91.4675	94.3833	94.6470	104.1773	109.1421	120.2864	(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	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	247.1073	273.5831	247.1073	255.3442	247.1073	255.3442	247.1073	247.1073	255.3442	247.1073	255.3442	247.1073	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	456.2370	460.9713	449.0410	423.6427	391.5820	361.4495	341.3191	336.5848	348.5151	373.9134	405.9740	436.1066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	(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)													
	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	(71)
Water heating gains (Table 5)													
	163.2175	160.3602	154.8564	142.7944	135.4060	127.6832	122.9402	126.8593	131.4541	140.0233	151.5862	161.6753	(72)
Total internal gains													
	939.4919	967.8447	923.9349	894.7116	847.0255	814.4072	781.2968	780.4816	805.2437	833.9742	885.8347	917.8194	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8600	10.6334	0.6300	0.7000	0.7700	2.7947	(74)
East	12.0500	19.6403	0.6300	0.7000	0.7700	72.3280	(76)
South	1.7200	46.7521	0.6300	0.7000	0.7700	24.5754	(78)
West	19.1300	19.6403	0.6300	0.7000	0.7700	114.8244	(80)
North	1.1800	16.7973	0.6300	0.7000	1.0000	7.8669	(82)
East	0.5900	26.6072	0.6300	0.7000	1.0000	6.2306	(82)
South	1.1800	42.0754	0.6300	0.7000	1.0000	19.7057	(82)
Horizontal	3.4500	26.0000	0.6300	0.7000	1.0000	35.6019	(82)

Solar gains	283.9276	549.7170	900.2048	1318.6884	1630.1140	1676.9840	1593.0199	1357.4521	1047.6379	650.1283	352.7801	234.4044	(83)
Total gains	1223.4196	1517.5618	1824.1397	2213.4000	2477.1395	2491.3911	2374.3167	2137.9338	1852.8815	1484.1025	1238.6148	1152.2238	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.1996	34.2851	34.3693	34.7702	34.8463	35.2048	35.2048	35.2720	35.0658	34.8463	34.6928	34.5337	
alpha	3.2800	3.2857	3.2913	3.3180	3.3231	3.3470	3.3470	3.3515	3.3377	3.3231	3.3129	3.3022	
util living area													
	0.9927	0.9848	0.9661	0.9123	0.8080	0.6519	0.5090	0.5729	0.8037	0.9523	0.9871	0.9940	(86)
MIT	18.6216	18.9139	19.3854	20.0164	20.5280	20.8409	20.9483	20.9232	20.6598	19.9569	19.1806	18.5829	(87)
Th 2	20.0706	20.0727	20.0748	20.0845	20.0863	20.0947	20.0947	20.0963	20.0915	20.0863	20.0826	20.0788	(88)
util rest of house													
	0.9914	0.9820	0.9596	0.8951	0.7701	0.5845	0.4167	0.4794	0.7504	0.9397	0.9842	0.9929	(89)
MIT 2	17.2410	17.6153	18.2154	19.0097	19.6225	19.9692	20.0658	20.0500	19.7906	18.9499	17.9639	17.1964	(90)
Living area fraction										fLA = Living area / (4) =		0.0657	(91)
MIT	17.3318	17.7006	18.2923	19.0759	19.6820	20.0265	20.1238	20.1073	19.8477	19.0161	18.0439	17.2876	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3318	17.7006	18.2923	19.0759	19.6820	20.0265	20.1238	20.1073	19.8477	19.0161	18.0439	17.2876	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9850	0.9712	0.9421	0.8713	0.7508	0.5790	0.4199	0.4806	0.7337	0.9194	0.9745	0.9875	(94)
Useful gains	1205.0454	1473.8039	1718.5803	1928.5887	1859.7998	1442.4670	996.8631	1027.5699	1359.4051	1364.4305	1206.9731	1137.8263	(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													
	3936.3404	3856.8797	3544.3696	3023.2595	2366.2810	1592.3049	1033.9929	1085.7866	1693.2580	2494.9674	3258.6877	3914.9541	(97)
Space heating kWh													
	2032.0834	1601.4269	1358.3873	788.1630	376.8220	0.0000	0.0000	0.0000	0.0000	841.1194	1477.2345	2066.1831	(98a)
Space heating requirement - total per year (kWh/year)												10541.4197	
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													
	2032.0834	1601.4269	1358.3873	788.1630	376.8220	0.0000	0.0000	0.0000	0.0000	841.1194	1477.2345	2066.1831	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10541.4197	
Space heating per m2											(98c) / (4) =	35.4333	(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													
	2032.0834	1601.4269	1358.3873	788.1630	376.8220	0.0000	0.0000	0.0000	0.0000	841.1194	1477.2345	2066.1831	(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)													
	2201.6072	1735.0238	1471.7089	853.9145	408.2579	0.0000	0.0000	0.0000	0.0000	911.2886	1600.4708	2238.5515	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	261.5299	231.1054	245.4117	215.9111	209.3007	188.6329	186.3654	193.8608	196.0559	218.5370	232.2080	258.7282	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6725	87.5547	87.2935	86.6974	85.3621	79.8000	79.8000	79.8000	79.8000	86.7815	87.4601	87.6993	(217)
Fuel for water heating, kWh/month													
	298.3031	263.9555	281.1340	249.0398	245.1915	236.3820	233.5406	242.9334	245.6841	251.8244	265.5017	295.0175	(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	51.3440	41.1901	37.0871	27.1716	20.9881	17.1475	19.1461	24.8868	32.3255	42.4128	47.9051	52.7710	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-105.0345	-141.4634	-194.1992	-207.9776	-215.5707	-197.7942	-194.9566	-187.9814	-174.8707	-156.3094	-112.9244	-91.5684	(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	-81.1674	-167.6926	-328.0105	-485.3570	-635.1133	-636.1017	-628.9636	-535.8423	-396.9599	-237.7493	-107.6336	-64.4539	(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												11420.8231	(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												3108.5076	(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)												414.3757	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-6285.6959	(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												8744.0105	(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	11420.8231	0.2100	2398.3729	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3108.5076	0.2100	652.7866	(264)
Space and water heating			3051.1594	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	414.3757	0.1443	59.8072	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1980.6506	0.1356	-268.6623	
PV Unit electricity exported	-4305.0452	0.1263	-543.8488	
Total			-812.5111	(269)
Total CO2, kg/year			2310.3848	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.7700	(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	11420.8231	1.1300	12905.5301	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3108.5076	1.1300	3512.6135	(278)
Space and water heating			16418.1437	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	414.3757	1.5338	635.5832	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1980.6506	1.5014	-2973.6973	
PV Unit electricity exported	-4305.0452	0.4637	-1996.3772	
Total			-4970.0745	(283)
Total Primary energy kWh/year			12213.7532	(286)
Target Primary Energy Rate (TPER)			41.0500	(287)

ii. Be Lean

Full SAP Calculation Printout

Property Reference	12 Spring Court	**Issued on Date**	07/03/2024
Assessment Reference	Option 2	**Prop Type Ref**	12 Spring Court
Property	12, Spring Court, ENFIELD, EN2 8JP		

SAP Rating	69 C	**DER**	5.67	**TER**	7.77
Environmental	94 A	**% DER < TER**			27.03
CO_2 Emissions (t/year)	1.49	**DFEE**	41.63	**TFEE**	39.94
Compliance Check	See BREL	**% DFEE < TFEE**			-4.24
% DPER < TPER	-42.01	**DPER**	58.30	**TPER**	41.05

Assessor Details	Mr. Mark Simons	**Assessor ID**	5542-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	127.1700 (1b)	x	2.6000 (2b)	=	330.6420	(1b) - (3b)
First floor	114.0400 (1c)	x	2.7500 (2c)	=	313.6100	(1c) - (3c)
Second floor	56.2900 (1d)	x	2.8500 (2d)	=	160.4265	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	297.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	804.6785	(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	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0373	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1873	(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) =	0.1873	(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	0.2388	0.2341	0.2294	0.2060	0.2013	0.1779	0.1779	0.1732	0.1873	0.2013	0.2107	0.2201	(22b)
Effective ac	0.5285	0.5274	0.5263	0.5212	0.5203	0.5158	0.5158	0.5150	0.5175	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 = 1.30)			33.7600	1.2357	41.7186			(27)
ENTRANCE DOOR			2.4500	1.3000	3.1850			(26)
ROOFLIGHTS			3.4500	1.2357	4.2633			(27a)
ROOFLIGHTS			0.5900	1.2357	0.7291			(27a)
ROOFLIGHTS			1.1800	1.2357	1.4582			(27a)
ROOFLIGHTS			1.1800	1.2357	1.4582			(27a)
UNDERGROUND			127.1700	0.1800	22.8906	110.0000	13988.7000	(28a)
External Wall	260.9100	36.2100	224.7000	0.1800	40.4460	70.0000	15729.0000	(29a)
Roof Void	25.1200		25.1200	0.1700	4.2704	70.0000	1758.4000	(29a)
Flat Roof	34.7600	3.4500	31.3100	0.1300	4.0703	9.0000	281.7900	(30)
Pitched @Ceiling	57.7500		57.7500	0.1221	7.0493	9.0000	519.7500	(30)
Pitched @Rafter	37.6600	2.9500	34.7100	0.1300	4.5123	9.0000	312.3900	(30)
Total net area of external elements Aum(A, m2)			543.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		136.0513			(33)
FF			114.0400			18.0000	2052.7200	(32d)
SF			56.2900			18.0000	1013.2200	(32d)
GF			114.0400			9.0000	1026.3600	(32e)
FF			56.2900			9.0000	506.6100	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 37188.9400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 125.0048 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.6300	0.3000	6.4890
E3 Sill	15.6400	0.0400	0.6256
E4 Jamb	47.1400	0.0500	2.3570
E5 Ground floor (normal)	50.2800	0.1600	8.0448
E20 Exposed floor (normal)	2.4400	0.3200	0.7808
E6 Intermediate floor within a dwelling	43.4900	0.0700	3.0443
E10 Eaves (insulation at ceiling level)	33.5800	0.0600	2.0148
E12 Gable (insulation at ceiling level)	12.3600	0.2400	2.9664
E14 Flat roof	11.0200	0.0400	0.4408
E16 Corner (normal)	23.4000	0.0900	2.1060
E17 Corner (inverted - internal area greater than external area)	7.8000	-0.0900	-0.7020
E16 Corner (normal)	16.5000	0.0900	1.4850
E17 Corner (inverted - internal area greater than external area)	5.5000	-0.0900	-0.4950
R1 Head of roof window	7.0900	0.0800	0.5672
R2 Sill of roof window	5.8450	0.0600	0.3507
R3 Jamb of roof window	9.3400	0.0800	0.7472
R1 Head of roof window	1.8000	0.0400	0.0720
R8 Roof to wall (rafter)	28.5500	0.0600	1.7130
R9 Roof to wall (flat ceiling)	22.2400	0.0400	0.8896

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 33.4972 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 169.5485 (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	140.3423	140.0484	139.7602	138.4068	138.1536	136.9748	136.9748	136.7565	137.4289	138.1536	138.6659	139.2014	(38)
Heat transfer coeff	309.8908	309.5969	309.3087	307.9553	307.7021	306.5233	306.5233	306.3050	306.9773	307.7021	308.2143	308.7499	(39)

Average = Sum(39)m / 12 = 307.9541

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0416	1.0407	1.0397	1.0351	1.0343	1.0303	1.0303	1.0296	1.0319	1.0343	1.0360	1.0378	(40)
HLP (average)												1.0351	
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 3.1287 (42)

Hot water usage for mixer showers												
	76.6776	75.5253	73.8461	70.6334	68.2624	65.6184	64.1155	65.7820	67.6087	70.4476	73.7293	76.3838 (42a)
Hot water usage for baths												
	34.8390	34.3216	33.5930	32.2496	31.2436	30.1282	29.5257	30.2492	31.0370	32.2305	33.6016	34.7213 (42b)
Hot water usage for other uses												
	49.1272	47.3407	45.5543	43.7678	41.9814	40.1950	40.1950	41.9814	43.7678	45.5543	47.3407	49.1272 (42c)

Average daily hot water use (litres/day) 147.6565 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	160.6438	157.1876	152.9934	146.6508	141.4874	135.9415	133.8361	138.0126	142.4135	148.2324	154.6717	160.2322	(44)
Energy conte	254.4205	223.8331	235.1452	200.7576	190.4693	167.1560	161.8632	170.8884	175.6101	201.1500	220.3582	250.8849	(45)

Energy content (annual) Total = Sum(45)m = 2452.5364

Distribution loss (46)m = 0.15 x (45)m												
	38.1631	33.5750	35.2718	30.1136	28.5704	25.0734	24.2795	25.6333	26.3415	30.1725	33.0537	37.6327 (46)
Water storage loss:												
Store volume												175.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0800 (55)
Total storage loss												
	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (56)
If cylinder contains dedicated solar storage												
	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (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												
	311.1629	275.0843	291.8876	255.6696	247.2117	222.0680	218.6056	227.6308	230.5221	257.8924	275.2702	307.6273 (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												
	311.1629	275.0843	291.8876	255.6696	247.2117	222.0680	218.6056	227.6308	230.5221	257.8924	275.2702	307.6273 (64)

Total per year (kWh/year) = Sum(64)m = 3120.6324 (64)
12Total per year (kWh/year) 3121 (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												
	129.9887	115.4255	123.5797	110.6815	108.7250	99.5090	99.2134	102.2143	102.3200	112.2763	117.1987	128.8132 (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	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	247.1073	273.5831	247.1073	255.3442	247.1073	255.3442	247.1073	247.1073	255.3442	247.1073	255.3442	247.1073	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.2370	460.9713	449.0410	423.6427	391.5820	361.4495	341.3191	336.5848	348.5151	373.9134	405.9740	436.1066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	(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)	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	(71)
Water heating gains (Table 5)	174.7160	171.7641	166.1017	153.7243	146.1357	138.2069	133.3514	137.3848	142.1111	150.9090	162.7760	173.1360	(72)
Total internal gains	947.9905	976.2487	932.1802	902.6415	854.7553	824.9308	791.7080	791.0072	815.9006	841.8599	894.0245	926.2801	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8600	10.6334	0.6300	0.7000	0.7700	2.7947	(74)
East	12.0500	19.6403	0.6300	0.7000	0.7700	72.3280	(76)
South	1.7200	46.7521	0.6300	0.7000	0.7700	24.5754	(78)
West	19.1300	19.6403	0.6300	0.7000	0.7700	114.8244	(80)
North	1.1800	16.7973	0.6300	0.7000	1.0000	7.8669	(82)
East	0.5900	26.6072	0.6300	0.7000	1.0000	6.2306	(82)
South	1.1800	42.0754	0.6300	0.7000	1.0000	19.7057	(82)
Horizontal	3.4500	26.0000	0.6300	0.7000	1.0000	35.6019	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	283.9276	549.7170	900.2048	1318.6884	1630.1140	1676.9840	1593.0199	1357.4521	1047.6379	650.1283	352.7801	234.4044	(83)
Total gains	1231.9181	1525.9657	1832.3850	2221.3299	2484.8693	2501.9148	2384.7280	2148.4593	1863.5385	1491.9882	1246.8046	1160.6845	(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	33.3352	33.3668	33.3979	33.5447	33.5723	33.7014	33.7014	33.7254	33.6515	33.5723	33.5165	33.4583	
alpha	3.2223	3.2245	3.2265	3.2363	3.2382	3.2468	3.2468	3.2484	3.2434	3.2382	3.2344	3.2306	
util living area	0.9925	0.9846	0.9663	0.9148	0.8149	0.6648	0.5232	0.5870	0.8107	0.9530	0.9868	0.9938	(86)
Living	19.0787	19.2956	19.6500	20.1207	20.5176	20.7669	20.8584	20.8368	20.6238	20.0817	19.4917	19.0393	
Non living	17.7571	18.0345	18.4853	19.0763	19.5525	19.8276	19.9106	19.8961	19.6868	19.0381	18.2892	17.7089	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	0	0	0	0	0	1	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	25	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	20.5176	20.7669	20.8584	20.8368	20.6238	20.4325	21.0000	21.0000	(87)
Th 2	20.0488	20.0496	20.0504	20.0541	20.0549	20.0581	20.0581	20.0587	20.0569	20.0549	20.0534	20.0519	(88)
util rest of house	0.9911	0.9818	0.9598	0.8977	0.7769	0.5955	0.4262	0.4895	0.7571	0.9404	0.9839	0.9927	(89)
MIT 2	20.0488	20.0496	20.0504	20.0541	19.5525	19.8276	19.9106	19.8961	19.6868	19.5290	20.0534	20.0519	(90)
Living area fraction										fLA = Living area / (4) =		0.0657	(91)
MIT	20.1113	20.1120	20.1128	20.1163	19.6159	19.8893	19.9728	19.9579	19.7483	19.5883	20.1156	20.1142	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1113	20.1120	20.1128	20.1163	19.6159	19.8893	19.9728	19.9579	19.7483	19.5883	20.1156	20.1142	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9912	0.9820	0.9603	0.8989	0.7564	0.5818	0.4168	0.4781	0.7361	0.9327	0.9842	0.9928	(94)
Useful gains	1221.1038	1498.4841	1759.5734	1996.7533	1879.4666	1455.4978	993.8807	1027.0922	1371.7258	1391.5171	1227.0486	1152.2874	(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	4899.7703	4709.6004	4210.5545	3454.1207	2435.7466	1621.2908	1033.8564	1089.8178	1733.9139	2765.7298	4011.6045	4913.5201	(97)
Space heating kWh	2736.9278	2157.8701	1823.5300	1049.3045	413.8724	0.0000	0.0000	0.0000	0.0000	1022.4143	2004.8802	2798.3571	(98a)
Space heating requirement - total per year (kWh/year)												14007.1564	
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	2736.9278	2157.8701	1823.5300	1049.3045	413.8724	0.0000	0.0000	0.0000	0.0000	1022.4143	2004.8802	2798.3571	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												14007.1564	
Space heating per m2											(98c) / (4) =	47.0829	(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 %) 165.8985 (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	2736.9278	2157.8701	1823.5300	1049.3045	413.8724	0.0000	0.0000	0.0000	0.0000	1022.4143	2004.8802	2798.3571	(98)
Space heating efficiency (main heating system 1)	165.8985	165.8985	165.8985	165.8985	165.8985	0.0000	0.0000	0.0000	0.0000	165.8985	165.8985	165.8985	(210)
Space heating fuel (main heating system)	1649.7600	1300.7167	1099.1838	632.4977	249.4732	0.0000	0.0000	0.0000	0.0000	616.2889	1208.4977	1686.7882	(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	311.1629	275.0843	291.8876	255.6696	247.2117	222.0680	218.6056	227.6308	230.5221	257.8924	275.2702	307.6273	(64)
Efficiency of water heater												139.5219	(216)
(217)m	139.5219	139.5219	139.5219	139.5219	139.5219	139.5219	139.5219	139.5219	139.5219	139.5219	139.5219	139.5219	(217)
Fuel for water heating, kWh/month	223.0208	197.1620	209.2055	183.2469	177.1848	159.1635	156.6819	163.1505	165.2228	184.8400	197.2953	220.4867	(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	52.3659	42.0099	37.8252	27.7124	21.4058	17.4888	19.5271	25.3821	32.9688	43.2569	48.8585	53.8213	(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	8443.2061	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	139.5219	
Water heating fuel used	2236.6607	(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)	422.6227	(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	11102.4895	(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	8443.2061	0.1551	1309.8232	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2236.6607	0.1410	315.2900	(264)
Space and water heating			1625.1132	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	422.6227	0.1443	60.9975	(268)
Total CO2, kg/year			1686.1107	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.6700	(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	8443.2061	1.5743	13292.5116	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2236.6607	1.5212	3402.4959	(278)
Space and water heating			16695.0075	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	422.6227	1.5338	648.2328	(282)
Total Primary energy kWh/year			17343.2403	(286)
Dwelling Primary energy Rate (DPER)			58.3000	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	127.1700 (1b)	x	2.6000 (2b)	=	330.6420	(1b) - (3b)
First floor	114.0400 (1c)	x	2.7500 (2c)	=	313.6100	(1c) - (3c)
Second floor	56.2900 (1d)	x	2.8500 (2d)	=	160.4265	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	297.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	804.6785	(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) =	0.0497	(8)

Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.2997	(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) = 0.2997	(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	0.3821	0.3746	0.3671	0.3297	0.3222	0.2847	0.2847	0.2772	0.2997	0.3222	0.3372	0.3522	(22b)
Effective ac	0.5730	0.5702	0.5674	0.5543	0.5519	0.5405	0.5405	0.5384	0.5449	0.5519	0.5568	0.5620	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.4500	1.0000	2.4500			(26)
TER Opening Type (Uw = 1.20)			33.7600	1.1450	38.6565			(27)
ROOFLIGHTS			3.4500	1.5918	5.4916			(27a)
ROOFLIGHTS			0.5900	1.5918	0.9391			(27a)
ROOFLIGHTS			1.1800	1.5918	1.8783			(27a)
ROOFLIGHTS			1.1800	1.5918	1.8783			(27a)
UNDERGROUND			127.1700	0.1300	16.5321			(28a)
External Wall	260.9100	36.2100	224.7000	0.1800	40.4460			(29a)
Roof Void	25.1200		25.1200	0.1800	4.5216			(29a)
Flat Roof	34.7600	3.4500	31.3100	0.1100	3.4441			(30)
Pitched @Ceiling	57.7500		57.7500	0.1100	6.3525			(30)
Pitched @Rafter	37.6600	2.9500	34.7100	0.1100	3.8181			(30)
Total net area of external elements Aum(A, m2)			543.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		126.4082			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	125.0048	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.6300	0.0500	1.0815
E3 Sill	15.6400	0.0500	0.7820
E4 Jamb	47.1400	0.0500	2.3570
E5 Ground floor (normal)	50.2800	0.1600	8.0448
E20 Exposed floor (normal)	2.4400	0.3200	0.7808
E6 Intermediate floor within a dwelling	43.4900	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	33.5800	0.0600	2.0148
E12 Gable (insulation at ceiling level)	12.3600	0.0600	0.7416
E14 Flat roof	11.0200	0.0800	0.8816
E16 Corner (normal)	23.4000	0.0900	2.1060
E17 Corner (inverted - internal area greater than external area)	7.8000	-0.0900	-0.7020
E16 Corner (normal)	16.5000	0.0900	1.4850
E17 Corner (inverted - internal area greater than external area)	5.5000	-0.0900	-0.4950
R1 Head of roof window	7.0900	0.0800	0.5672
R2 Sill of roof window	5.8450	0.0600	0.3507
R3 Jamb of roof window	9.3400	0.0800	0.7472
R1 Head of roof window	1.8000	0.0800	0.1440
R8 Roof to wall (rafter)	28.5500	0.0600	1.7130
R9 Roof to wall (flat ceiling)	22.2400	0.0400	0.8896

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	23.4898	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	149.8980	(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	152.1597	151.4068	150.6689	147.2028	146.5543	143.5355	143.5355	142.9764	144.6983	146.5543	147.8662	149.2377	(38)
Heat transfer coeff	302.0576	301.3048	300.5669	297.1008	296.4523	293.4334	293.4334	292.8744	294.5962	296.4523	297.7642	299.1357	(39)
Average = Sum(39)m / 12 =												297.0977	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0153	1.0128	1.0103	0.9987	0.9965	0.9863	0.9863	0.9845	0.9902	0.9965	1.0009	1.0055	(40)
HLP (average)												0.9986	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.1287	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
76.6776	75.5253	73.8461	70.6334	68.2624	65.6184	64.1155	65.7820	67.6087	70.4476	73.7293	76.3838	(42a)

Hot water usage for baths

33.0971	32.6055	31.9134	30.6371	29.6814	28.6218	28.0494	28.7367	29.4851	30.6190	31.9216	32.9852	(42b)

Hot water usage for other uses

46.6708	44.9737	43.2766	41.5795	39.8823	38.1852	38.1852	39.8823	41.5795	43.2766	44.9737	46.6708	(42c)
Average daily hot water use (litres/day)												143.8084	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	156.4455	153.1045	149.0360	142.8499	137.8262	132.4254	130.3501	134.4010	138.6733	144.3432	150.6246	156.0398	(44)
Energy conte	247.7714	218.0188	229.0628	195.5544	185.5406	162.8324	157.6472	166.4165	170.9980	195.8723	214.5924	244.3206	(45)
Energy content (annual)										Total = Sum(45)m =		2388.6274	

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

37.1657	32.7028	34.3594	29.3332	27.8311	24.4249	23.6471	24.9625	25.6497	29.3808	32.1889	36.6481	(46)
Water storage loss:												
Store volume												175.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5263	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8242	(55)
Total storage loss													
25.5498	23.0773	25.5498	24.7257	25.5498	24.7257	25.5498	25.5498	24.7257	25.5498	24.7257	25.5498	(56)
If cylinder contains dedicated solar storage												
25.5498	23.0773	25.5498	24.7257	25.5498	24.7257	25.5498	25.5498	24.7257	25.5498	24.7257	25.5498	(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													

	296.5836	262.1073	277.8751	242.7920	234.3528	210.0701	206.4594	215.2288	218.2357	244.6846	261.8300	293.1329	(62)
WWHRS	-35.0538	-31.0019	-32.4634	-26.8809	-25.0521	-21.4372	-20.0940	-21.3679	-22.1798	-26.1475	-29.6220	-34.4046	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	261.5299	231.1054	245.4117	215.9111	209.3007	188.6329	186.3654	193.8608	196.0559	218.5370	232.2080	258.7282	(64)
										Total per year (kWh/year) = Sum(64)m =		2637.6471	(64)
12Total per year (kWh/year)												2638	(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													
	121.4338	107.7620	115.2132	102.8120	100.7420	91.9319	91.4675	94.3833	94.6470	104.1773	109.1421	120.2864	(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	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	247.1073	273.5831	247.1073	255.3442	247.1073	255.3442	247.1073	247.1073	255.3442	247.1073	255.3442	247.1073	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	456.2370	460.9713	449.0410	423.6427	391.5820	361.4495	341.3191	336.5848	348.5151	373.9134	405.9740	436.1066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	(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)													
	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	(71)
Water heating gains (Table 5)													
	163.2175	160.3602	154.8564	142.7944	135.4060	127.6832	122.9402	126.8593	131.4541	140.0233	151.5862	161.6753	(72)
Total internal gains													
	939.4919	967.8447	923.9349	894.7116	847.0255	814.4072	781.2968	780.4816	805.2437	833.9742	885.8347	917.8194	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8600	10.6334	0.6300	0.7000	0.7700	2.7947	(74)
East	12.0500	19.6403	0.6300	0.7000	0.7700	72.3280	(76)
South	1.7200	46.7521	0.6300	0.7000	0.7700	24.5754	(78)
West	19.1300	19.6403	0.6300	0.7000	0.7700	114.8244	(80)
North	1.1800	16.7973	0.6300	0.7000	1.0000	7.8669	(82)
East	0.5900	26.6072	0.6300	0.7000	1.0000	6.2306	(82)
South	1.1800	42.0754	0.6300	0.7000	1.0000	19.7057	(82)
Horizontal	3.4500	26.0000	0.6300	0.7000	1.0000	35.6019	(82)

Solar gains	283.9276	549.7170	900.2048	1318.6884	1630.1140	1676.9840	1593.0199	1357.4521	1047.6379	650.1283	352.7801	234.4044	(83)
Total gains	1223.4196	1517.5618	1824.1397	2213.4000	2477.1395	2491.3911	2374.3167	2137.9338	1852.8815	1484.1025	1238.6148	1152.2238	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.1996	34.2851	34.3693	34.7702	34.8463	35.2048	35.2048	35.2720	35.0658	34.8463	34.6928	34.5337	
alpha	3.2800	3.2857	3.2913	3.3180	3.3231	3.3470	3.3470	3.3515	3.3377	3.3231	3.3129	3.3022	
util living area													
	0.9927	0.9848	0.9661	0.9123	0.8080	0.6519	0.5090	0.5729	0.8037	0.9523	0.9871	0.9940	(86)
MIT	18.6216	18.9139	19.3854	20.0164	20.5280	20.8409	20.9483	20.9232	20.6598	19.9569	19.1806	18.5829	(87)
Th 2	20.0706	20.0727	20.0748	20.0845	20.0863	20.0947	20.0947	20.0963	20.0915	20.0863	20.0826	20.0788	(88)
util rest of house													
	0.9914	0.9820	0.9596	0.8951	0.7701	0.5845	0.4167	0.4794	0.7504	0.9397	0.9842	0.9929	(89)
MIT 2	17.2410	17.6153	18.2154	19.0097	19.6225	19.9692	20.0658	20.0500	19.7906	18.9499	17.9639	17.1964	(90)
Living area fraction										fLA = Living area / (4) =		0.0657	(91)
MIT	17.3318	17.7006	18.2923	19.0759	19.6820	20.0265	20.1238	20.1073	19.8477	19.0161	18.0439	17.2876	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3318	17.7006	18.2923	19.0759	19.6820	20.0265	20.1238	20.1073	19.8477	19.0161	18.0439	17.2876	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9850	0.9712	0.9421	0.8713	0.7508	0.5790	0.4199	0.4806	0.7337	0.9194	0.9745	0.9875	(94)
Useful gains	1205.0454	1473.8039	1718.5803	1928.5887	1859.7998	1442.4670	996.8631	1027.5699	1359.4051	1364.4305	1206.9731	1137.8263	(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													
	3936.3404	3856.8797	3544.3696	3023.2595	2366.2810	1592.3049	1033.9929	1085.7866	1693.2580	2494.9674	3258.6877	3914.9541	(97)
Space heating kWh													
	2032.0834	1601.4269	1358.3873	788.1630	376.8220	0.0000	0.0000	0.0000	0.0000	841.1194	1477.2345	2066.1831	(98a)
Space heating requirement - total per year (kWh/year)												10541.4197	
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													
	2032.0834	1601.4269	1358.3873	788.1630	376.8220	0.0000	0.0000	0.0000	0.0000	841.1194	1477.2345	2066.1831	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10541.4197	
Space heating per m2											(98c) / (4) =	35.4333	(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													
	2032.0834	1601.4269	1358.3873	788.1630	376.8220	0.0000	0.0000	0.0000	0.0000	841.1194	1477.2345	2066.1831	(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)													
	2201.6072	1735.0238	1471.7089	853.9145	408.2579	0.0000	0.0000	0.0000	0.0000	911.2886	1600.4708	2238.5515	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	261.5299	231.1054	245.4117	215.9111	209.3007	188.6329	186.3654	193.8608	196.0559	218.5370	232.2080	258.7282	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6725	87.5547	87.2935	86.6974	85.3621	79.8000	79.8000	79.8000	79.8000	86.7815	87.4601	87.6993	(217)
Fuel for water heating, kWh/month													
	298.3031	263.9555	281.1340	249.0398	245.1915	236.3820	233.5406	242.9334	245.6841	251.8244	265.5017	295.0175	(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	51.3440	41.1901	37.0871	27.1716	20.9881	17.1475	19.1461	24.8868	32.3255	42.4128	47.9051	52.7710	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-105.0345	-141.4634	-194.1992	-207.9776	-215.5707	-197.7942	-194.9566	-187.9814	-174.8707	-156.3094	-112.9244	-91.5684	(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	-81.1674	-167.6926	-328.0105	-485.3570	-635.1133	-636.1017	-628.9636	-535.8423	-396.9599	-237.7493	-107.6336	-64.4539	(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												11420.8231	(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												3108.5076	(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)												414.3757	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-6285.6959	(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												8744.0105	(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	11420.8231	0.2100	2398.3729	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3108.5076	0.2100	652.7866	(264)
Space and water heating			3051.1594	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	414.3757	0.1443	59.8072	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1980.6506	0.1356	-268.6623	
PV Unit electricity exported	-4305.0452	0.1263	-543.8488	
Total			-812.5111	(269)
Total CO2, kg/year			2310.3848	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.7700	(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	11420.8231	1.1300	12905.5301	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3108.5076	1.1300	3512.6135	(278)
Space and water heating			16418.1437	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	414.3757	1.5338	635.5832	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1980.6506	1.5014	-2973.6973	
PV Unit electricity exported	-4305.0452	0.4637	-1996.3772	
Total			-4970.0745	(283)
Total Primary energy kWh/year			12213.7532	(286)
Target Primary Energy Rate (TPER)			41.0500	(287)

iii. Be Green

Full SAP Calculation Printout

Property Reference	12 Spring Court	**Issued on Date**	07/03/2024
Assessment Reference	Option 3	**Prop Type Ref**	12 Spring Court
Property	12, Spring Court, ENFIELD, EN2 8JP		

SAP Rating	91 B	**DER**	1.56	**TER**	7.77
Environmental	98 A	**% DER < TER**			79.92
CO_2 Emissions (t/year)	0.39	**DFEE**	36.40	**TFEE**	39.94
Compliance Check	See BREL	**% DFEE < TFEE**			8.86
% DPER < TPER	57.74	**DPER**	17.37	**TPER**	41.10

Assessor Details	Mr. Mark Simons	**Assessor ID**	5542-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	127.1700 (1b)	x	2.6000 (2b)	=	330.6420	(1b) - (3b)
First floor	114.0400 (1c)	x	2.7500 (2c)	=	313.6100	(1c) - (3c)
Second floor	56.2900 (1d)	x	2.8500 (2d)	=	160.4265	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 297.5000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	804.6785	(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	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0373	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1873	(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) =	0.1873	(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	0.2388	0.2341	0.2294	0.2060	0.2013	0.1779	0.1779	0.1732	0.1873	0.2013	0.2107	0.2201	(22b)
Effective ac	0.5285	0.5274	0.5263	0.5212	0.5203	0.5158	0.5158	0.5150	0.5175	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 = 1.00)			33.7600	0.9615	32.4615			(27)
ENTRANCE DOOR			2.4500	1.0000	2.4500			(26)
ROOFLIGHTS			3.4500	0.9615	3.3173			(27a)
ROOFLIGHTS			0.5900	0.9615	0.5673			(27a)
ROOFLIGHTS			1.1800	0.9615	1.1346			(27a)
ROOFLIGHTS			1.1800	0.9615	1.1346			(27a)
UNDERGROUND			127.1700	0.1100	13.9887	110.0000	13988.7000	(28a)
External Wall	260.9100	36.2100	224.7000	0.1500	33.7050	70.0000	15729.0000	(29a)
Roof Void	25.1200		25.1200	0.1400	3.5168	70.0000	1758.4000	(29a)
Flat Roof	34.7600	3.4500	31.3100	0.1000	3.1310	9.0000	281.7900	(30)
Pitched @Ceiling	57.7500		57.7500	0.0952	5.5000	9.0000	519.7500	(30)
Pitched @Rafter	37.6600	2.9500	34.7100	0.1000	3.4710	9.0000	312.3900	(30)
Total net area of external elements Aum(A, m2)			543.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		104.3779			(33)
FF			114.0400			18.0000	2052.7200	(32d)
SF			56.2900			18.0000	1013.2200	(32d)
GF			114.0400			9.0000	1026.3600	(32e)
FF			56.2900			9.0000	506.6100	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 37188.9400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 125.0048 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.6300	0.3000	6.4890
E3 Sill	15.6400	0.0400	0.6256
E4 Jamb	47.1400	0.0500	2.3570
E5 Ground floor (normal)	50.2800	0.1600	8.0448
E20 Exposed floor (normal)	2.4400	0.3200	0.7808
E6 Intermediate floor within a dwelling	43.4900	0.0700	3.0443
E10 Eaves (insulation at ceiling level)	33.5800	0.0600	2.0148
E12 Gable (insulation at ceiling level)	12.3600	0.2400	2.9664
E14 Flat roof	11.0200	0.0400	0.4408
E16 Corner (normal)	23.4000	0.0900	2.1060
E17 Corner (inverted - internal area greater than external area)	7.8000	-0.0900	-0.7020
E16 Corner (normal)	16.5000	0.0900	1.4850
E17 Corner (inverted - internal area greater than external area)	5.5000	-0.0900	-0.4950
R1 Head of roof window	7.0900	0.0800	0.5672
R2 Sill of roof window	5.8450	0.0600	0.3507
R3 Jamb of roof window	9.3400	0.0800	0.7472
R1 Head of roof window	1.8000	0.0400	0.0720
R8 Roof to wall (rafter)	28.5500	0.0600	1.7130
R9 Roof to wall (flat ceiling)	22.2400	0.0400	0.8896

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 33.4972 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 137.8751 (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	140.3423	140.0484	139.7602	138.4068	138.1536	136.9748	136.9748	136.7565	137.4289	138.1536	138.6659	139.2014	(38)
Heat transfer coeff	278.2174	277.9235	277.6353	276.2819	276.0287	274.8499	274.8499	274.6316	275.3040	276.0287	276.5409	277.0765	(39)
Average = Sum(39)m / 12 =												276.2807	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9352	0.9342	0.9332	0.9287	0.9278	0.9239	0.9239	0.9231	0.9254	0.9278	0.9295	0.9313	(40)
HLP (average)												0.9287	
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 3.1287 (42)
Hot water usage for mixer showers

76.6776	75.5253	73.8461	70.6334	68.2624	65.6184	64.1155	65.7820	67.6087	70.4476	73.7293	76.3838	(42a)

Hot water usage for baths

34.8390	34.3216	33.5930	32.2496	31.2436	30.1282	29.5257	30.2492	31.0370	32.2305	33.6016	34.7213	(42b)

Hot water usage for other uses

49.1272	47.3407	45.5543	43.7678	41.9814	40.1950	40.1950	41.9814	43.7678	45.5543	47.3407	49.1272	(42c)

Average daily hot water use (litres/day) 147.6565 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	160.6438	157.1876	152.9934	146.6508	141.4874	135.9415	133.8361	138.0126	142.4135	148.2324	154.6717	160.2322	(44)
Energy conte	254.4205	223.8331	235.1452	200.7576	190.4693	167.1560	161.8632	170.8884	175.6101	201.1500	220.3582	250.8849	(45)
Energy content (annual)										Total = Sum(45)m =		2452.5364	
Distribution loss (46)m = 0.15 x (45)m	38.1631	33.5750	35.2718	30.1136	28.5704	25.0734	24.2795	25.6333	26.3415	30.1725	33.0537	37.6327	(46)
Water storage loss:													
Store volume												189.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.5200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.3608	(55)
Total storage loss	42.1848	38.1024	42.1848	40.8240	42.1848	40.8240	42.1848	42.1848	40.8240	42.1848	40.8240	42.1848	(56)
If cylinder contains dedicated solar storage	42.1848	38.1024	42.1848	40.8240	42.1848	40.8240	42.1848	42.1848	40.8240	42.1848	40.8240	42.1848	(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	319.8677	282.9467	300.5924	264.0936	255.9165	230.4920	227.3104	236.3356	238.9461	266.5972	283.6942	316.3321	(62)
WWHRS	-71.7358	-63.4437	-66.4346	-55.0105	-51.2678	-43.8702	-41.1213	-43.7284	-45.3898	-53.5096	-60.6199	-70.4074	(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	248.1319	219.5029	234.1577	209.0831	204.6487	186.6217	186.1891	192.6071	193.5563	213.0876	223.0743	245.9248	(64)
										Total per year (kWh/year) = Sum(64)m =		2556.5852	(64)
12Total per year (kWh/year)												2557	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	136.9526	121.7154	130.5435	117.4207	115.6888	106.2482	106.1773	109.1781	109.0592	119.2401	123.9379	135.7770	(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	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	247.1073	273.5831	247.1073	255.3442	247.1073	255.3442	247.1073	247.1073	255.3442	247.1073	255.3442	247.1073	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	456.2370	460.9713	449.0410	423.6427	391.5820	361.4495	341.3191	336.5848	348.5151	373.9134	405.9740	436.1066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	(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)	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	(71)
Water heating gains (Table 5)	184.0760	181.1241	175.4617	163.0843	155.4957	147.5669	142.7114	146.7448	151.4711	160.2690	172.1360	182.4960	(72)
Total internal gains	957.3505	985.6087	941.5402	912.0015	864.1153	834.2908	801.0680	800.3672	825.2606	851.2199	903.3845	935.6401	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8600	10.6334	0.6300	0.7000	0.7700	2.7947	(74)
East	12.0500	19.6403	0.6300	0.7000	0.7700	72.3280	(76)
South	1.7200	46.7521	0.6300	0.7000	0.7700	24.5754	(78)
West	19.1300	19.6403	0.6300	0.7000	0.7700	114.8244	(80)
North	1.1800	16.7973	0.6300	0.7000	1.0000	7.8669	(82)
East	0.5900	26.6072	0.6300	0.7000	1.0000	6.2306	(82)
South	1.1800	42.0754	0.6300	0.7000	1.0000	19.7057	(82)
Horizontal	3.4500	26.0000	0.6300	0.7000	1.0000	35.6019	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	283.9276	549.7170	900.2048	1318.6884	1630.1140	1676.9840	1593.0199	1357.4521	1047.6379	650.1283	352.7801	234.4044	(83)
Total gains	1241.2781	1535.3257	1841.7450	2230.6899	2494.2293	2511.2748	2394.0880	2157.8193	1872.8985	1501.3482	1256.1646	1170.0445	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1302	37.1694	37.2080	37.3903	37.4246	37.5851	37.5851	37.6150	37.5231	37.4246	37.3553	37.2831	
alpha	3.4753	3.4780	3.4805	3.4927	3.4950	3.5057	3.5057	3.5077	3.5015	3.4950	3.4904	3.4855	
util living area	0.9925	0.9840	0.9632	0.9033	0.7886	0.6251	0.4812	0.5447	0.7833	0.9477	0.9863	0.9939	(86)
Living	19.2801	19.4949	19.8350	20.2760	20.6244	20.8214	20.8847	20.8700	20.7047	20.2184	19.6649	19.2412	
Non living	18.0768	18.3514	18.7834	19.3351	19.7488	19.9629	20.0190	20.0096	19.8502	19.2741	18.5727	18.0293	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1202	19.4949	19.8350	20.2760	20.6244	20.8214	20.8847	20.8700	20.7047	20.2184	19.6649	19.4872	(87)
Th 2	20.1377	20.1385	20.1393	20.1432	20.1439	20.1473	20.1473	20.1479	20.1460	20.1439	20.1425	20.1409	(88)
util rest of house	0.9912	0.9811	0.9565	0.8854	0.7505	0.5608	0.3967	0.4577	0.7299	0.9345	0.9834	0.9928	(89)
MIT 2	19.3161	18.3514	18.7834	19.3351	19.7488	19.9629	20.0190	20.0096	19.8502	19.2741	18.5727	18.4099	(90)
Living area fraction										fLA = Living area / (4) =		0.0657	(91)
MIT	19.3689	18.4265	18.8525	19.3969	19.8063	20.0193	20.0759	20.0661	19.9063	19.3361	18.6445	18.4806	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3689	18.4265	18.8525	19.3969	19.8063	20.0193	20.0759	20.0661	19.9063	19.3361	18.6445	18.4806	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9897	0.9732	0.9433	0.8667	0.7336	0.5504	0.3893	0.4489	0.7127	0.9182	0.9763	0.9899	(94)
Useful gains	1228.5076	1494.2525	1737.3473	1933.3394	1829.6803	1382.1920	932.0493	968.5545	1334.7563	1378.6062	1226.3354	1158.2020	(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	4192.4403	3759.3312	3429.4953	2900.1086	2237.5831	1489.4871	955.3456	1006.8358	1598.5042	2411.4255	3192.5185	3956.8317	(97)
Space heating kWh	2205.1660	1522.1329	1258.9581	696.0738	303.4796	0.0000	0.0000	0.0000	0.0000	768.4175	1415.6518	2082.1805	(98a)
Space heating requirement - total per year (kWh/year)												10252.0602	
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	2205.1660	1522.1329	1258.9581	696.0738	303.4796	0.0000	0.0000	0.0000	0.0000	768.4175	1415.6518	2082.1805	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10252.0602	
Space heating per m2											(98c) / (4) =	34.4607	(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 %) 417.7026 (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	2205.1660	1522.1329	1258.9581	696.0738	303.4796	0.0000	0.0000	0.0000	0.0000	768.4175	1415.6518	2082.1805	(98)
Space heating efficiency (main heating system 1)	417.7026	417.7026	417.7026	417.7026	417.7026	0.0000	0.0000	0.0000	0.0000	417.7026	417.7026	417.7026	(210)
Space heating fuel (main heating system)	527.9272	364.4059	301.4006	166.6434	72.6545	0.0000	0.0000	0.0000	0.0000	183.9628	338.9138	498.4839	(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	248.1319	219.5029	234.1577	209.0831	204.6487	186.6217	186.1891	192.6071	193.5563	213.0876	223.0743	245.9248	(64)
Efficiency of water heater												175.5896	(216)
(217)m	175.5896	175.5896	175.5896	175.5896	175.5896	175.5896	175.5896	175.5896	175.5896	175.5896	175.5896	175.5896	(217)
Fuel for water heating, kWh/month	141.3136	125.0091	133.3551	119.0749	116.5495	106.2829	106.0365	109.6917	110.2322	121.3555	127.0430	140.0566	(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	52.3659	42.0099	37.8252	27.7124	21.4058	17.4888	19.5271	25.3821	32.9688	43.2569	48.8585	53.8213	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-29.6954	-46.4514	-76.5982	-100.2955	-119.7433	-113.4173	-110.6183	-96.1375	-75.0134	-56.0635	-33.8642	-25.1556	(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	-5.3456	-12.6405	-29.7874	-57.2217	-92.7555	-104.0886	-100.2920	-75.2207	-46.2873	-20.6338	-7.7254	-4.2034	(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	2454.3921	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	175.5896	
Water heating fuel used	1456.0005	(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)	422.6227	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1439.2557	(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	2893.7596	(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	2454.3921	0.1554	381.3396	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1456.0005	0.1405	204.6260	(264)
Space and water heating			585.9656	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	422.6227	0.1443	60.9975	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-883.0536	0.1323	-116.7867	
PV Unit electricity exported	-556.2020	0.1199	-66.7111	
Total			-183.4979	(269)
Total CO2, kg/year			463.4652	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.5600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2454.3921	1.5752	3866.1116	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1456.0005	1.5196	2212.6067	(278)
Space and water heating			6078.7183	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	422.6227	1.5338	648.2328	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-883.0536	1.4887	-1314.5579	
PV Unit electricity exported	-556.2020	0.4399	-244.6508	
Total			-1559.2087	(283)
Total Primary energy kWh/year			5167.7424	(286)
Dwelling Primary energy Rate (DPER)			17.3700	(287)

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

CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	127.1700 (1b)	x	2.6000 (2b)	=	330.6420	(1b) - (3b)
First floor	114.0400 (1c)	x	2.7500 (2c)	=	313.6100	(1c) - (3c)
Second floor	56.2900 (1d)	x	2.8500 (2d)	=	160.4265	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	297.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	804.6785	(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) =	0.0497	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2997	(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) =	0.2997	(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	0.3821	0.3746	0.3671	0.3297	0.3222	0.2847	0.2847	0.2772	0.2997	0.3222	0.3372	0.3522	(22b)
Effective ac	0.5730	0.5702	0.5674	0.5543	0.5519	0.5405	0.5405	0.5384	0.5449	0.5519	0.5568	0.5620	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.4500	1.0000	2.4500			(26)
TER Opening Type (Uw = 1.20)			33.7600	1.1450	38.6565			(27)
ROOFLIGHTS			3.4500	1.5918	5.4916			(27a)
ROOFLIGHTS			0.5900	1.5918	0.9391			(27a)
ROOFLIGHTS			1.1800	1.5918	1.8783			(27a)
ROOFLIGHTS			1.1800	1.5918	1.8783			(27a)
UNDERGROUND			127.1700	0.1300	16.5321			(28a)
External Wall	260.9100	36.2100	224.7000	0.1800	40.4460			(29a)
Roof Void	25.1200		25.1200	0.1800	4.5216			(29a)
Flat Roof	34.7600	3.4500	31.3100	0.1100	3.4441			(30)
Pitched @Ceiling	57.7500		57.7500	0.1100	6.3525			(30)
Pitched @Rafter	37.6600	2.9500	34.7100	0.1100	3.8181			(30)
Total net area of external elements Aum(A, m2)			543.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		126.4082			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	125.0048	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.6300	0.0500	1.0815
E3 Sill	15.6400	0.0500	0.7820
E4 Jamb	47.1400	0.0500	2.3570
E5 Ground floor (normal)	50.2800	0.1600	8.0448
E20 Exposed floor (normal)	2.4400	0.3200	0.7808
E6 Intermediate floor within a dwelling	43.4900	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	33.5800	0.0600	2.0148
E12 Gable (insulation at ceiling level)	12.3600	0.0600	0.7416
E14 Flat roof	11.0200	0.0800	0.8816
E16 Corner (normal)	23.4000	0.0900	2.1060
E17 Corner (inverted - internal area greater than external area)	7.8000	-0.0900	-0.7020
E16 Corner (normal)	16.5000	0.0900	1.4850
E17 Corner (inverted - internal area greater than external area)	5.5000	-0.0900	-0.4950
R1 Head of roof window	7.0900	0.0800	0.5672
R2 Sill of roof window	5.8450	0.0600	0.3507
R3 Jamb of roof window	9.3400	0.0800	0.7472
R1 Head of roof window	1.8000	0.0800	0.1440
R8 Roof to wall (rafter)	28.5500	0.0600	1.7130
R9 Roof to wall (flat ceiling)	22.2400	0.0400	0.8896

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	23.4898	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 149.8980	(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	152.1597	151.4068	150.6689	147.2028	146.5543	143.5355	143.5355	142.9764	144.6983	146.5543	147.8662	149.2377	(38)
Heat transfer coeff	302.0576	301.3048	300.5669	297.1008	296.4523	293.4334	293.4334	292.8744	294.5962	296.4523	297.7642	299.1357	(39)
Average = Sum(39)m / 12 =												297.0977	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0153	1.0128	1.0103	0.9987	0.9965	0.9863	0.9863	0.9845	0.9902	0.9965	1.0009	1.0055	(40)
HLP (average)												0.9986	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.1287	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	76.6776	75.5253	73.8461	70.6334	68.2624	65.6184	64.1155	65.7820	67.6087	70.4476	73.7293	76.3838	(42a)
Hot water usage for baths	33.0971	32.6055	31.9134	30.6371	29.6814	28.6218	28.0494	28.7367	29.4851	30.6190	31.9216	32.9852	(42b)
Hot water usage for other uses	46.6708	44.9737	43.2766	41.5795	39.8823	38.1852	38.1852	39.8823	41.5795	43.2766	44.9737	46.6708	(42c)
Average daily hot water use (litres/day)												143.8084	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	156.4455	153.1045	149.0360	142.8499	137.8262	132.4254	130.3501	134.4010	138.6733	144.3432	150.6246	156.0398	(44)
Energy conte	247.7714	218.0188	229.0628	195.5544	185.5406	162.8324	157.6472	166.4165	170.9980	195.8723	214.5924	244.3206	(45)
Energy content (annual)										Total = Sum(45)m =		2388.6274	
Distribution loss (46)m = 0.15 x (45)m	37.1657	32.7028	34.3594	29.3332	27.8311	24.4249	23.6471	24.9625	25.6497	29.3808	32.1889	36.6481	(46)
Water storage loss:													
Store volume												189.0000	(47)

a) If manufacturer declared loss factor is known (kWh/day): 1.5977 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8627 (55)
Total storage loss
26.7451 24.1569 26.7451 25.8824 26.7451 25.8824 26.7451 26.7451 25.8824 26.7451 25.8824 26.7451 (56)
If cylinder contains dedicated solar storage
26.7451 24.1569 26.7451 25.8824 26.7451 25.8824 26.7451 26.7451 25.8824 26.7451 25.8824 26.7451 (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
297.7789 263.1869 279.0704 243.9488 235.5481 211.2268 207.6547 216.4241 219.3924 245.8798 262.9867 294.3282 (62)
WWHRS -35.0538 -31.0019 -32.4634 -26.8809 -25.0521 -21.4372 -20.0940 -21.3679 -22.1798 -26.1475 -29.6220 -34.4046 (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
262.7251 232.1850 246.6070 217.0678 210.4960 189.7896 187.5607 195.0561 197.2126 219.7323 233.3648 259.9235 (64)
Total per year (kWh/year) = Sum(64)m = 2651.7206 (64)
12Total per year (kWh/year) 2652 (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
122.3900 108.6257 116.1694 103.7373 101.6983 92.8573 92.4237 95.3395 95.5723 105.1336 110.0675 121.2426 (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	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	156.4340	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	247.1073	273.5831	247.1073	255.3442	247.1073	255.3442	247.1073	247.1073	255.3442	247.1073	255.3442	247.1073	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	456.2370	460.9713	449.0410	423.6427	391.5820	361.4495	341.3191	336.5848	348.5151	373.9134	405.9740	436.1066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	38.6434	(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)													
	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	-125.1472	(71)
Water heating gains (Table 5)													
	164.5027	161.6454	156.1417	144.0796	136.6912	128.9685	124.2254	128.1445	132.7394	141.3086	152.8715	162.9605	(72)
Total internal gains													
	940.7772	969.1300	925.2202	895.9968	848.3108	815.6924	782.5821	781.7669	806.5289	835.2594	887.1200	919.1046	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8600	10.6334	0.6300	0.7000	0.7700	2.7947	(74)
East	12.0500	19.6403	0.6300	0.7000	0.7700	72.3280	(76)
South	1.7200	46.7521	0.6300	0.7000	0.7700	24.5754	(78)
West	19.1300	19.6403	0.6300	0.7000	0.7700	114.8244	(80)
North	1.1800	16.7973	0.6300	0.7000	1.0000	7.8669	(82)
East	0.5900	26.6072	0.6300	0.7000	1.0000	6.2306	(82)
South	1.1800	42.0754	0.6300	0.7000	1.0000	19.7057	(82)
Horizontal	3.4500	26.0000	0.6300	0.7000	1.0000	35.6019	(82)

Solar gains	283.9276	549.7170	900.2048	1318.6884	1630.1140	1676.9840	1593.0199	1357.4521	1047.6379	650.1283	352.7801	234.4044	(83)
Total gains	1224.7048	1518.8470	1825.4250	2214.6852	2478.4248	2492.6764	2375.6020	2139.2190	1854.1668	1485.3877	1239.9001	1153.5090	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.1996	34.2851	34.3693	34.7702	34.8463	35.2048	35.2048	35.2720	35.0658	34.8463	34.6928	34.5337	
alpha	3.2800	3.2857	3.2913	3.3180	3.3231	3.3470	3.3470	3.3515	3.3377	3.3231	3.3129	3.3022	
util living area													
	0.9927	0.9848	0.9660	0.9122	0.8078	0.6517	0.5088	0.5726	0.8035	0.9522	0.9870	0.9940	(86)
MIT	18.6224	18.9146	19.3861	20.0170	20.5284	20.8411	20.9484	20.9233	20.6602	19.9575	19.1814	18.5837	(87)
Th 2	20.0706	20.0727	20.0748	20.0845	20.0863	20.0947	20.0947	20.0963	20.0915	20.0863	20.0826	20.0788	(88)
util rest of house													
	0.9913	0.9820	0.9596	0.8950	0.7699	0.5843	0.4165	0.4792	0.7502	0.9396	0.9842	0.9929	(89)
MIT 2	17.2420	17.6162	18.2163	19.0104	19.6229	19.9693	20.0658	20.0500	19.7910	18.9507	17.9649	17.1974	(90)
Living area fraction									fLA = Living area / (4) =			0.0657	(91)
MIT	17.3327	17.7015	18.2931	19.0765	19.6824	20.0266	20.1238	20.1074	19.8481	19.0169	18.0448	17.2885	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3327	17.7015	18.2931	19.0765	19.6824	20.0266	20.1238	20.1074	19.8481	19.0169	18.0448	17.2885	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9849	0.9711	0.9420	0.8712	0.7506	0.5788	0.4197	0.4804	0.7334	0.9192	0.9744	0.9875	(94)
Useful gains	1206.2600	1474.9601	1719.6248	1929.4001	1860.3029	1442.6749	996.9284	1027.6769	1359.8701	1365.3937	1208.1421	1139.0519	(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													
	3936.6349	3857.1633	3544.6294	3023.4597	2366.3985	1592.3488	1034.0059	1085.8082	1693.3649	2495.2055	3258.9713	3915.2485	(97)
Space heating kWh													
	2031.3989	1600.8406	1357.8034	787.7229	376.5352	0.0000	0.0000	0.0000	0.0000	840.5800	1476.5970	2065.4903	(98a)
Space heating requirement - total per year (kWh/year)												10536.9683	
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													

	2031.3989	1600.8406	1357.8034	787.7229	376.5352	0.0000	0.0000	0.0000	0.0000	840.5800	1476.5970	2065.4903	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10536.9683	
Space heating per m2											(98c) / (4) =	35.4184	(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													
	2031.3989	1600.8406	1357.8034	787.7229	376.5352	0.0000	0.0000	0.0000	0.0000	840.5800	1476.5970	2065.4903	(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)													
	2200.8656	1734.3885	1471.0763	853.4376	407.9471	0.0000	0.0000	0.0000	0.0000	910.7042	1599.7801	2237.8010	(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													
	262.7251	232.1850	246.6070	217.0678	210.4960	189.7896	187.5607	195.0561	197.2126	219.7323	233.3648	259.9235	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6677	87.5493	87.2869	86.6879	85.3484	79.8000	79.8000	79.8000	79.8000	86.7719	87.4539	87.6945	(217)
Fuel for water heating, kWh/month													
	299.6830	265.2049	282.5248	250.4016	246.6314	237.8316	235.0385	244.4312	247.1336	253.2297	266.8431	296.3966	(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	51.3440	41.1901	37.0871	27.1716	20.9881	17.1475	19.1461	24.8868	32.3255	42.4128	47.9051	52.7710	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-105.0345	-141.4634	-194.1992	-207.9776	-215.5707	-197.7942	-194.9566	-187.9814	-174.8707	-156.3094	-112.9244	-91.5684	(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	-81.1674	-167.6926	-328.0105	-485.3570	-635.1133	-636.1017	-628.9636	-535.8423	-396.9599	-237.7493	-107.6336	-64.4539	(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												11416.0003	(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												3125.3498	(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)												414.3757	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-6285.6959	(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												8756.0299	(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	11416.0003	0.2100	2397.3601	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3125.3498	0.2100	656.3235	(264)
Space and water heating			3053.6835	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	414.3757	0.1443	59.8072	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1980.6506	0.1356	-268.6623	
PV Unit electricity exported	-4305.0452	0.1263	-543.8488	
Total			-812.5111	(269)
Total CO2, kg/year			2312.9089	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.7700	(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	11416.0003	1.1300	12900.0803	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3125.3498	1.1300	3531.6453	(278)
Space and water heating			16431.7257	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	414.3757	1.5338	635.5832	(282)

Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1980.6506	1.5014	-2973.6973	
PV Unit electricity exported	-4305.0452	0.4637	-1996.3772	
Total			-4970.0745	(283)
Total Primary energy kWh/year			12227.3352	(286)
Target Primary Energy Rate (TPER)			41.1000	(287)

B. GHA Overheating Tool

EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019

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.

Good Homes Alliance

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	0
Day - barriers some of the time, or for some windows e.g. on quiet side	4	
Night - reasons to keep all windows closed	8	0
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	0

#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	0

#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	0
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
Dual aspect		2	3

3

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

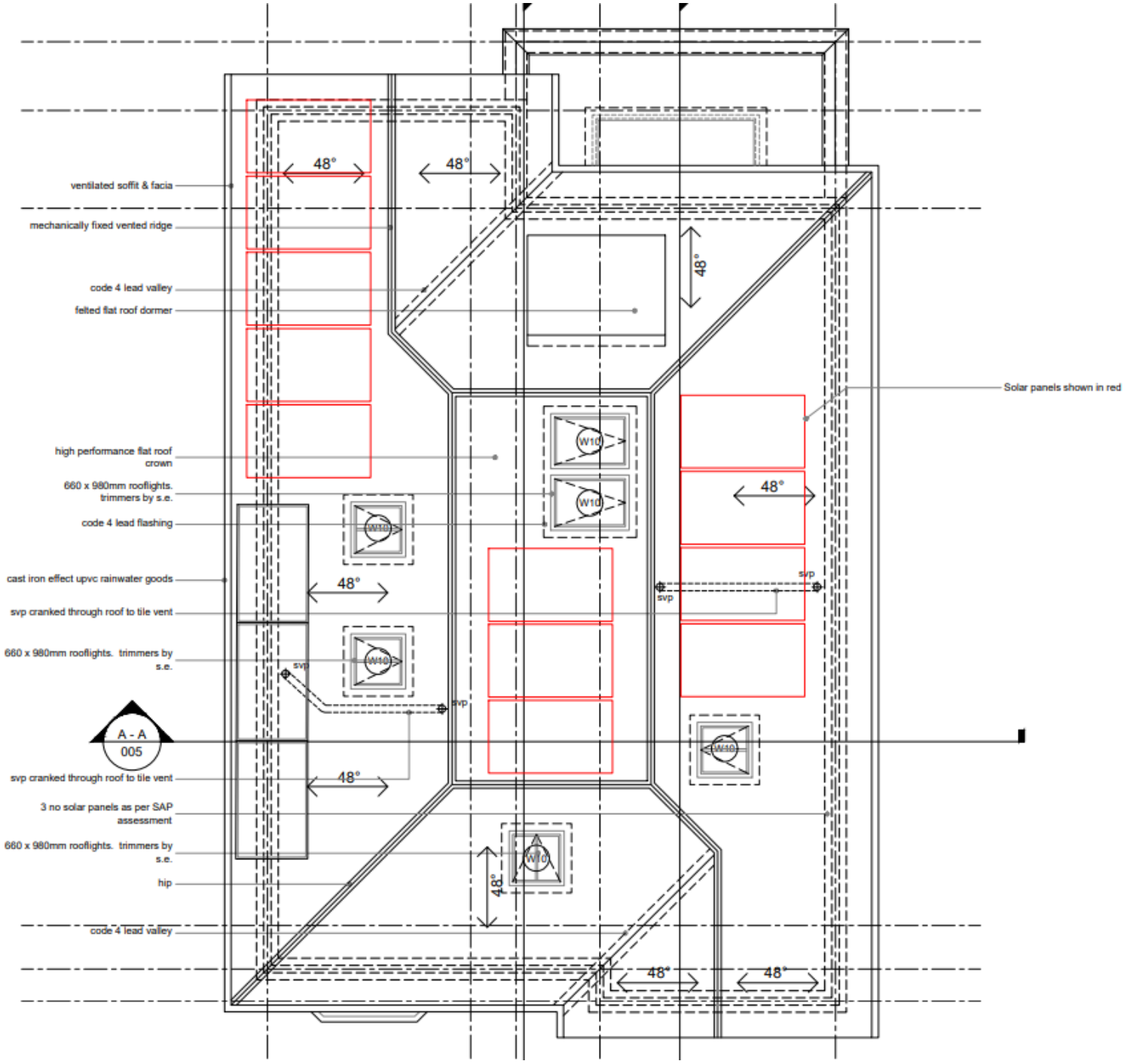
High 12 **Medium** 8 **Low**

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)

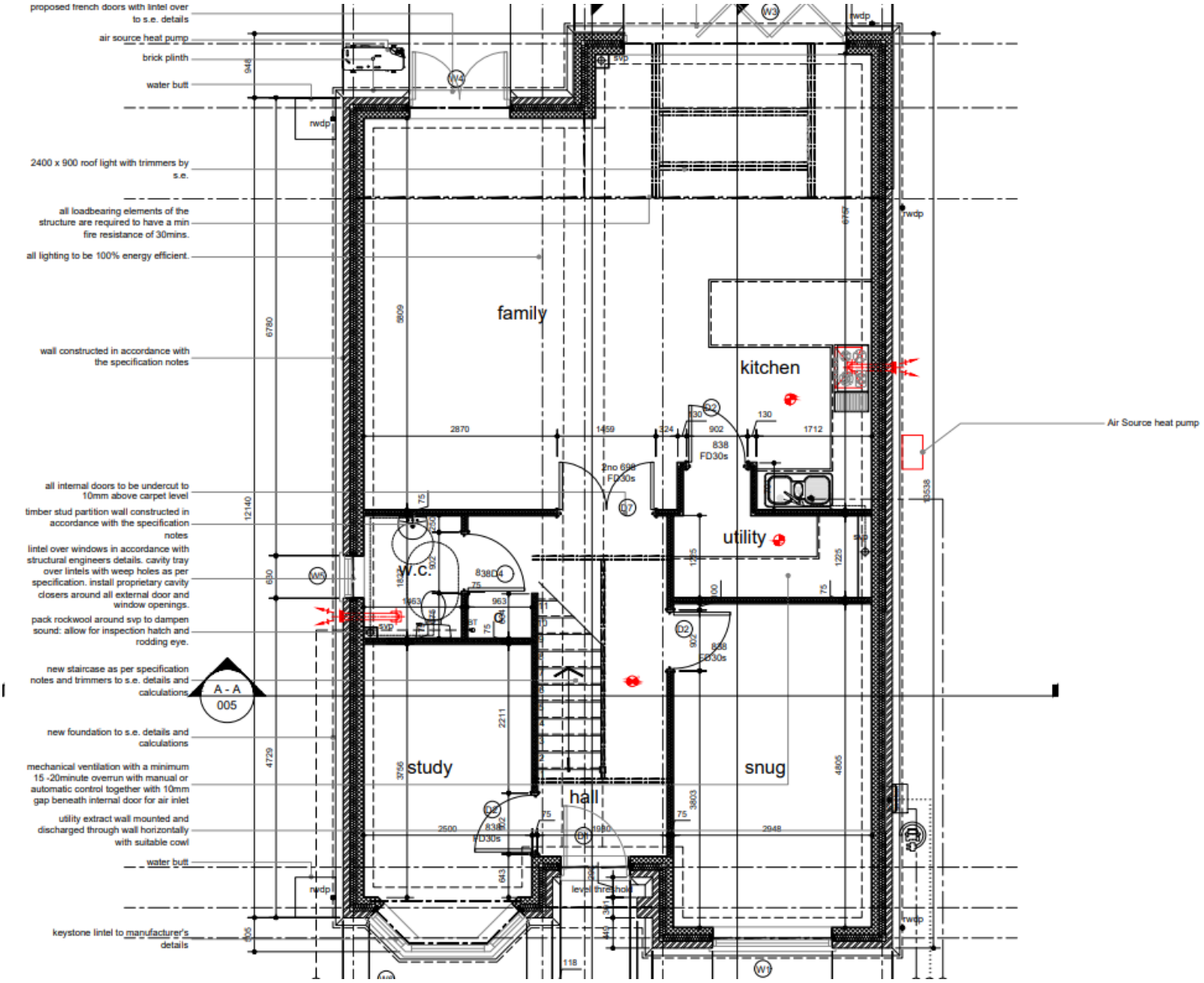
score between 8 and 12:
Seek design changes to reduce risk factors and/or increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

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

C. Roof Plan


ventilated soffit & facia
mechanically fixed vented ridge
code 4 lead valley
felted flat roof dormer
high performance flat roof crown
660 x 980mm rooflights. trimmers by s.e.
code 4 lead flashing
cast iron effect upvc rainwater goods
svp cranked through roof to tile vent
660 x 980mm rooflights. trimmers by s.e.
A - A
005
svp cranked through roof to tile vent
3 no solar panels as per SAP assessment
660 x 980mm rooflights. trimmers by s.e.
hip
code 4 lead valley
Solar panels shown in red
48°
W10
svp

D. MEP Plan


proposed french doors with lintel over to s.e. details
air source heat pump
brick plinth
water butt
2400 x 900 roof light with trimmers by s.e.
all loadbearing elements of the structure are required to have a min fire resistance of 30mins.
all lighting to be 100% energy efficient.
wall constructed in accordance with the specification notes
all internal doors to be undercut to 10mm above carpet level
timber stud partition wall constructed in accordance with the specification notes
lintel over windows in accordance with structural engineers details. cavity tray over lintels with weep holes as per specification. install proprietary cavity closers around all external door and window openings.
pack rockwool around svp to dampen sound: allow for inspection hatch and rodding eye.
new staircase as per specification notes and trimmers to s.e. details and calculations
A - A
005
new foundation to s.e. details and calculations
mechanical ventilation with a minimum 15 -20minute overrun with manual or automatic control together with 10mm gap beneath internal door for air inlet
utility extract wall mounted and discharged through wall horizontally with suitable cowl
water butt
keystone lintel to manufacturer's details
family
kitchen
utility
W.C.
study
hall
snug
rwdp
svp
level threshold
Air Source heat pump