RESI RESOLVE
sustainability

STANMORE HOUSE, EWEN

ENERGY STRATEGY AND SUSTAINABILITY STATEMENT

JANUARY• 2024

CONTENTS

1 EXECUTIVE SUMMARY

1.1 This Energy Strategy and Sustainability Statement has been prepared by Resi Resolve, appointed by JVAT Developments to demonstrate how the development of 3 detached dwellings will meet the requirements of the following policies of Cotswold District Local Plan 2011-2031 (Adopted 3 August 2018):

- Policy EN1 – Built, Natural and Historic Environment
- Policy EN2 – Design of The Building and Natural Environment

1.2 This report will utilise the following guidance and resources:

- Cotswold Design Code. Paragraphs D.59 – D.62
- Net Zero Carbon Toolkit
- Supplementary Planning Document

1.3 The strategy outlined within this report demonstrates that the development achieves a total 60% reduction in regulated carbon dioxide, using the SAP 10 methodology and the Carbon Emissions Reporting Spreadsheet.

1.4 The resultant carbon savings at each stage of the energy hierarchy is displayed in Tables 1, 2 and Figure 1 below.

	Carbon dioxide emissions (tonnes CO_2 per annum)
	Regulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	5.5
After energy demand reductions (be lean)	5.3
After heat network connection (be clean)	4.5
After renewable energy (be green)	2.2

Table 1: Carbon dioxide emissions after each stage of the energy hierarchy

	Regulated carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reductions	0.2	4%
Be clean: Savings from heat network	0.8	14%
Be green: Savings from renewable energy	2.3	42%
Cumulative on-site savings	3.3	60%

Table 2: Regulated carbon dioxide savings from each stage of the energy hierarchy

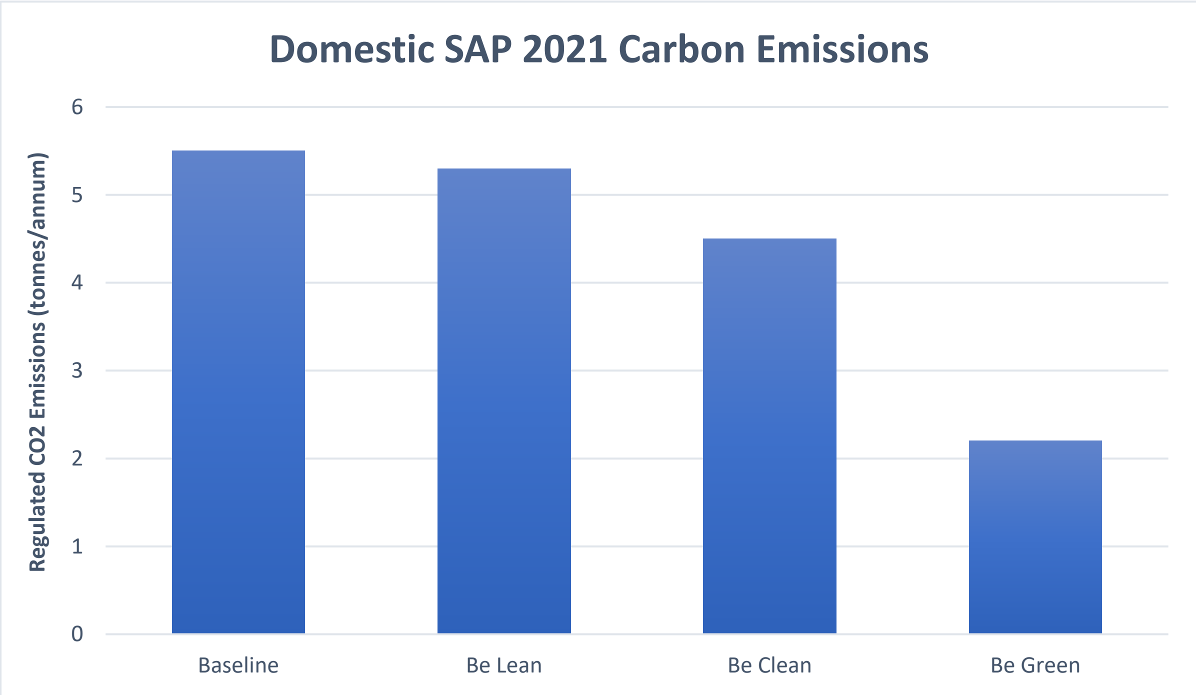


Figure 1: Regulated carbon dioxide emissions, savings, and targets

1.5 A Sustainability Statement has been prepared (Part 2) which addresses the applicant's dedication to key sustainability issues, including water use reductions, waste minimisation, the protection and enhancement of ecological features, health and well-being, and reduction in pollution.

2 INTRODUCTION

2.1 This Energy Strategy and Sustainability Statement has been prepared by Resi Resolve, appointed by JVAT Developments (hereafter referred to as the Applicant) to review and report on the carbon reduction strategy for the construction of 3 new dwellings at Stanmore House, Ewen.

Figure 2: Site Masterplan

3 METHODOLOGY

3.1 Resi Resolve will carry out a comprehensive review of the sustainability principles outlined within Cotswold District Local Plan (2011-2031).

3.2 This strategy will identify the carbon footprint for the development at Stanmore House after each stage of the energy hierarchy.

ESTABLISHING CO2 EMISSIONS

3.3 The Energy Strategy will clearly identify the carbon footprint of the new dwellings after each stage of the energy hierarchy. The following tables will be used to demonstrate compliance with the energy hierarchy and the carbon targets. Savings will be expressed in tonnes of CO_2 per annum, not kg CO_2/m2 per annum.

	Carbon dioxide emissions (tonnes CO_2 per annum)
	Regulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	A
After energy demand reductions (be lean)	B
After heat network connection (be clean)	C
After renewable energy (be green)	D

Table 3: The Energy Hierarchy

	Regulated carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reductions	A – B	(A – B)/A * 100
Be clean: Savings from heat network	B – C	(B – C)/A * 100
Be green: Savings from renewable energy	C – D	(C – D)/A * 100
Cumulative on-site savings	A – D = E	(A – D)/A * 100

Table 4: Regulated carbon dioxide savings from each stage of the energy hierarchy

CALCULATING REGULATED CO2 EMISSIONS FOR A PART L 2021 COMPLIANT DEVELOPMENT

3.4 The Carbon Reduction Strategy will establish the regulated CO_2 emissions after achieving compliance with Building Regulations Approved Document Part L. This will be established using approved compliance methodology, SAP 10 for Dwellings.

CALCULATING REGULATED CO2 EMISSION AT EACH STAGE OF THE ENERGY HIERARCHY

3.5 Energy consumed in the operation of space heating/cooling and hot-water systems, ventilation and internal lighting is classified as regulated emissions. Regulation emissions will be calculated using the method outlined within the GLA Energy Assessment Guidance (a robust, overarching report that can be used to supplement the development of all Energy Strategies). The Guidance states that regulated emissions must establish:

"Dwellings: A Dwelling CO2 Emissions Rate (DER) calculated through the Part L 2021 of the Building Regulations methodology SAP 10.2. This is multiplied by the cumulative floor area for the particular dwelling type in question to give the related CO_2 emissions. In terms of the extent of modelling work required, the applicant must provide information for a representative sample of residential properties."

3.6 The Design SAP (Predicted Energy Assessments and Building Regulations Compliance Reports) will be submitted for review and approval by the local planning authority to confirm the construction specification before works start on site.

SUSTAINABILITY

3.7 The Applicant has an aspiration to incorporate sustainable design principles beyond minimum standards. These will be explored further in the Section 2: Sustainability.

4 PLANNING POLICY

4.1 To support the planning application for the proposed development, Resi Resolve has carried out a comprehensive review of the developments opportunities to embrace sustainability principles outlined within the Cotswold District Local Plan (2011-2031).

4.2 This report outlines how the Applicant's proposals at Stanmore House will respond to Policy EN1 (Built, Natural and Historic Environment) and EN2 (Design of the Built and Natural Environment) of Cotswold District Local Plan (2011-2031).

4.3 The specific wording is provided below:

POLICY EN1 – BUILT, NATURAL AND HISTORIC ENVIRONMENT

"New development will, where appropriate, promote the protection, conservation and enhancement of the historic and natural environment by:

- *a) ensuring the protection and enhancement of existing natural and historic environmental assets and their settings in proportion with the significance of the asset;*
- *b) contributing to the provision and enhancement of multi-functional green infrastructure;*
- *c) addressing climate change, habitat loss and fragmentation through creating new habitats and the better management of existing habitats;*
- *d) seeking to improve air, soil and water quality where feasible; and*
- *e) ensuring design standards that complement the character of the area and the sustainable use of the development."*

POLICY EN2 – DESIGN OF THE BUILT AND NATURAL ENVIRONMENT

"Development will be permitted which accords with the Cotswold Design Code (Appendix D). Proposals should be of design quality that respects the character and distinctive appearance of the locality."

*The **Cotswold Design Code** states the following:*

"D.59 There is now a greater awareness of the need to ensure that developments are sustainable in their design and construction. The potential impacts of climate change can be

addressed through a variety of means, from the incorporation of better insulation and renewable energy technologies, to adaptations for severe weather events, and the use of local and recycled building materials. Re-use of existing buildings is also often more environmentally sustainable than demolition and newbuild.

D.60 Elements of sustainable construction can be applied through retrofit, by altering existing buildings, and a spart of new build developments. Many aspects of sustainable design need to be considered at the onset of site planning to ensure that they can be achieved, for example the use of building orientation to maximise passive solar gain or sustainable drainage systems (SuDS).

D.61 Other issues are controlled via the Building Control system, but property owners and developers are encouraged to exceed the requirements of those regulations. Detailed guidance on sustainable design is not provided within this Code as there is sufficient guidance provided elsewhere, for example, in the PPG and from Historic England.

D.62 Sustainable design needs to be responsive to the character of the area and the sensitivities of the site. For example, a careful and sympathetic approach is required when dealing with listed buildings, and buildings in conservation areas or other sensitive historic or landscape settings, including the Area of Outstanding Natural Beauty. Some measures maybe more appropriate in certain contexts than others.”

5 PART 1: ENERGY STRATEGY

5.1 Resi Resolve has carried out an energy assessment for the proposed development at Stanmore House to satisfy the requirements outlined within Cotswold District Local Plan (2011-2031).

5.2 CO_2 savings for the new build dwellings are shown at each stage of the energy hierarchy throughout this strategy.

5.3 The Applicant is committed to making the fullest contribution to minimising carbon dioxide emissions for the dwellings in accordance with the energy hierarchy (be lean, be clean, be green). The Applicant has a commitment to exceed the requirements of Building Regulations Approved Document Part L.

5.4 The energy hierarchy is an approach to reducing carbon dioxide emissions in the built environment. "The first step is to reduce energy demand (be lean), the second step is to supply energy efficiently (be clean) and the third step is use renewable energy (be green)." (“Annex Six: Glossary | London City Hall”).

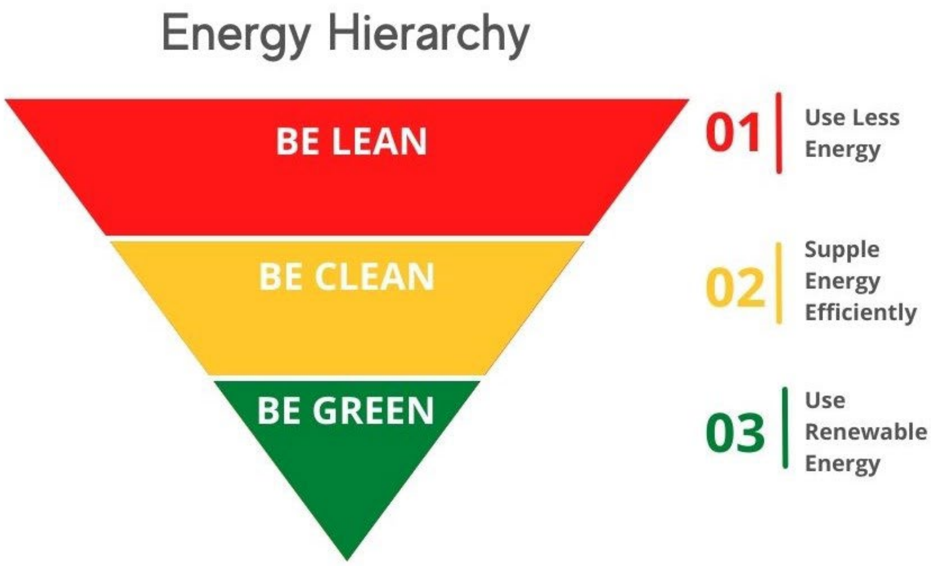


Figure 3: Energy Hierarchy

6 BUILDING REGULATIONS COMPLIANCE (BASELINE)

6.1 A Building Regulation (2021) baseline for energy demand has been calculated. The baseline is used as a foundation to demonstrate the reductions in carbon dioxide emissions that will result at each stage of the energy hierarchy.

6.2 The baseline requires compliance with the standards set by Building Regulations 'Approved Document Part L1 – Conservation of Fuel and Power in New Dwellings'. These standards include a minimum level for regulated carbon emissions defined by the Target Emission Rate (TER). The TER is calculated based on a 'Notional Building' which is automatically generated as part of the Standard Assessment Procedure (SAP) toolkit. There are also minimum levels of fabric efficiency set by the Target Fabric Energy Efficiency rating (TFEE) within SAP.

6.3 Individual gas-combi boilers have been used in the baseline calculations, following the recommendations of the Energy Assessment Guidance, Section 6.7 "When determining this baseline, it should be assumed that any heating and hot water supply would be provided by gas boilers and that any active cooling would be provided by electrically powered equipment". Individual gas-combi boilers will be assumed within the calculations until the consideration of renewable technologies at the 'Be Green' stage. Active cooling is not planned to be provided to the development.

6.4 Table 5 demonstrates the baseline carbon dioxide emissions. The calculated baseline has a total regulated carbon dioxide emissions of 5.5 tonnes CO_2 per annum. The SAP 10 output worksheets are provided in Appendix A of this report.

	Regulated carbon dioxide emissions (tonnes CO_2 per annum)
Baseline: Part L 2021 of the Building Regulations Compliant Development	5.5

Table 5: Baseline regulated carbon dioxide emissions

7 DEMAND REDUCTION (BE LEAN)

7.1 This strategy now considers both active and passive measures to reduce the energy demand of Stanmore House.

7.2 The following active and passive energy efficient measures are proposed:

ENHANCED PASSIVE MEASURES

7.3 The main fabric (thermal elements) of the dwellings will be improved beyond the requirements of Building Regulations, these include the external walls, party walls, floors, and roofs (including glazing in external windows and doors). This will be achieved by installing high levels of insulation which will significantly reduce the energy demand of the dwellings. Improvements over the limiting fabric measures will be incorporated into the design wherever practical.

INSULATION

7.4 Incorporating enhanced layers of insulation in the building envelope (walls, roofs, and floors), together with highly efficient double glazing is a highly sustainable approach as it locks in carbon emissions savings for the lifetime of the building. This strategy will deliver average U-values better than those demanded by Part L1 of 2021 Building Regulations. The proposed U-values for the new build dwellings are illustrated in Table 6. The Preliminary SAP Specification Summary is provided in Appendix C.

Thermal Element	Maximum Area-Weighted U-value (W/m^2K) Allowable Under 2021 Building Regulations	Applicant's Proposed U-value (W/m^2K) required to Meet 2021 Building Regulation Baseline	% Improvement on 2021 Allowable U-Value Standard
Main external walls	0.26	0.18	30.77
Roof	0.16	0.11	31.25
Ground floor	0.18	0.11	38.89
Windows/doors	1.6	1.3	18.75
	Average Improvement		29.92

Table 6: AD Part L1A 2021 Insulation Enhancement Proposals

7.5 Table 6 demonstrates that the enhanced U-values for new dwellings and their fabric thermal elements (walls, roof, floors, and glazing) will provide an average overall improvement of

29.92% against the requirements of Approved Document Part L1 2021 of the Building Regulations.

SPACE HEATING

7.6 The space heating requirement of the development will be minimised via the fabric measures detailed above. The proposed development at Stanmore House will also benefit from considerable passive solar gains due to its generally favourable orientation, designed to maximise sunlight penetration and reduce overshadowing, which will further reduce the space heating demand of the development. Furthermore, the internal layout of dwellings will be such that wherever practicable the living areas will face south and therefore benefit from a greater amount of solar gain than the rest of the dwelling, which does not have as high a heating demand.

AIR TIGHTNESS

7.7 Air tightness standards will conform to Approved Document Part L1 accredited details. These details incorporate an improvement over Building Regulations (SAP 10) requirements by reducing air leakage loss and convective bypass of insulation. An improvement of design air permeability from 10 to 4m3/hm2 further reduces space heating requirements.

THERMAL BRIDGES

7.8 In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges, which occur when highly conductive elements (e.g., metals) in the wall construction enable a low resistance escape route for heat. It is proposed that all dwellings within the development will comply with the Constructive Details for non-repeating thermal bridges.

LIGHTING AND APPLIANCES

7.9 100% of internal lighting throughout the development will be of the low energy type. External lighting will also be low energy and controlled through PIR sensors or daylight cut-off devices.

SUSTAINABLE DESIGN

7.10 The development is in keeping with the surrounding urban form in terms of height and massing. It has been designed in such a way that wind speeds will not be increased through the wind tunnel effect.

7.11 The orientation and configuration of development will make little contribution to urban heat island effect. Deciduous trees which can bring solar shading in summer and promote sunlight penetration in winter are to be incorporated as an aspect of the landscape plan. The creation of landscaping zones will also help to enhance the local microclimate and counter air pollution.

DEMONSTRATING CO2 SAVINGS FROM DEMAND REDUCTION MEASURES

7.12 Table 7 below shows the total regulated carbon emissions and percentage of carbon dioxide savings over the baseline when the passive and active measures are applied to the Stanmore House development. The SAP 10 output worksheets are provided in Appendix A of this report.

	Carbon dioxide emissions (tonnes CO_2 per annum)	Regulated carbon dioxide savings (%)
Baseline: Part L 2021 of the Building Regulations Compliant Development	5.5	-
After energy demand reductions (be lean)	5.3	4%
Total carbon dioxide savings (%)		4%

Table 7: Baseline and 'be lean' regulated carbon dioxide emissions

7.13 The 'be lean' case demonstrates total carbon dioxide emissions 5.3 tonnes CO_2 per annum. This is a total 4% reduction in regulated carbon emissions against the Part L compliant baseline.

8 HEATING INFRASTRUCTURE (BE CLEAN)

8.1 Following the reduction of energy demand outlined in the previous step (be lean), this strategy now considers the potential exploit of local energy resources and how energy can be supplied efficiently and cleanly to reduce CO_2 emissions. An appropriate heat source has been selected in accordance with the following heating hierarchy:

a) connect to local existing or planned heat networks
b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
c) use low-emission combined heat and power (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
d) use ultra-low NOx gas boilers

LOCAL EXISTING OR PLANNED HEAT NETWORK

8.2 Applicants must prioritise the connection to a heat network if in the vicinity of the proposed development and provide evidence of active two-way correspondence with the network operator.

8.3 Connection to a heat network is an efficient solution for providing space and water heating developments in an urban setting which has a high heat density, they also enable the use of secondary energy or waste heat sources. This creates low quality energy which can be used and re-used, to meet both low- and high-quality energy demands. Heat networks provide a system-level approach which allows demand to be managed through a storage provision and the protection of existing capacity in the local electricity network. This allows for added capacity for additional development and the ability to increase volumes of renewable energy into the grid mix.

8.4 Investigation into the potential for connecting the development to an existing heat network system has been undertaken using the Heat Network Planning Database (HNPD). Figure 4 below shows that the development is not situated in a high heat density area, and no future networks are planned.

Figure 4: Heat Network Planning Database search for Stanmore House

ZERO-EMISSION AND/OR LOCAL SECONDARY HEAT SOURCES

8.5 The second step of the heating hierarchy considers the use of locally available energy sources. It is recommended that secondary sources are used before renewable sources but can be used in conjunction.

8.6 Secondary heat includes environmental sources such as air, water, ground, and waste, for example:

- Heat from sewerage system
- Sewage treatment plants
- Tube network
- Data centres
- Chiller systems

8.7 Investigation into the potential for connecting the development to a local secondary heat source has been undertaken using the Renewable Energy Planning Database. Figure 5 below shows that the development is not situated near a secondary heat source.

Figure 5: Renewable Energy Planning Database search for Stanmore House

LOW-EMISSION COMBINED HEAT AND POWER (CHP)

8.8 CHP is suited for large, mixed-use developments where there is a diversity of energy uses and ongoing demand. These features allow electricity to be generated for extended periods and minimise the risk of an over-generation of heat. The total costs of any CHP installation would also be significant. It is more appropriate for the development to implement more cost effective and efficient measures to achieve a sustainable reduction in energy demand. This is backed by the GLA Energy Assessment Guidance which states that only *"larger sites are considered appropriate in terms of operational regime and available heat load to enable an effective operation of CHP systems, providing that any related emissions are properly abated."*

8.9 A considerable amount of renewable energy forms the UK electricity grid, with 30% of all generation from renewables in 2018 and 20% from nuclear, creating a continuing decarbonisation of the grid. This impacts the efficacy of the carbon reductions which can be attained from gas-fired CHP. Predictions states that electricity generated by CHP will be more carbon intensive than gas boilers by 2030. This will remove gas-fired CHP as carbon-saving measures and because of this combustion-based CHP should be avoided. A CHP approach utilising fuel cells to produce electricity through the electrochemical reaction of hydrogen and oxygen which produces heat as a by-product would be an acceptable approach however the commercial readiness and viability of these technologies is currently challenging.

8.10 For all the above reasons, the Applicant will not be installing CHP to Stanmore House.

ULTRA-LOW NOX GAS BOILERS

8.11 An ultra-low NOx gas boiler should only be considered when all previous stages of the energy hierarchy has been deemed unviable. This is the case for Stanmore House and the 'be clean' calculations have been calculated with a gas boiler. **Please note that this has been considered for the purpose of compliance with the methodological approach of the Energy Hierarchy and does not reflect the final recommended strategy at 'Be Green' stage.**

8.12 The boiler used for the purpose of the calculations at 'be clean' stage remains the same as that used within the baseline and 'be lean' case (class 5 gas boilers of greater than 90% efficiency). Stringent energy ratings of boilers means that new boilers on the market are highly energy efficient. Improvements have however been made to the heating controls. The dwellings will benefit from time and temperature zone control which allows future occupants to programme the heating times of at least two space heating zones independently, in addition to having independent heating controls. The boiler flow temperature has also been limited to between 35 degrees Celsius to provide further energy savings.

8.13 Table 8 below shows the total carbon emissions and percentage improvement over the baseline and 'be lean' stage when improved heating specifications are applied to the Stanmore House development. The SAP (2021) output worksheets are provided in Appendix A of this report.

	Carbon dioxide emissions (tonnes CO_2 per annum)	Regulated carbon dioxide savings (%)
Baseline: Part L 2021 of the Building Regulations Compliant Development	5.5	-
After energy demand reductions (be lean)	5.3	4%
After heat network connection (be clean)	4.5	14%
Total carbon dioxide savings (%)		18%

Table 8: Baseline, 'be lean' and 'be clean' regulated carbon dioxide emissions

8.14 The 'be clean' case demonstrates total carbon dioxide emissions of 4.5 tonnes CO_2 per annum. This is an 14% reduction in regulated carbon emissions against the 'be lean' case and a total carbon dioxide saving of 18%.

9 COOLING AND OVERHEATING

9.1 The following identifies any potential overheating risk and proposals to incorporate suitable passive measures to mitigate overheating and reduce cooling demand.

THE COOLING HIERARCHY

9.2 The cooling hierarchy should be applied to both major and minor developments. The below identifies the categories that should be addressed and the applicants' proposals:

1) Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure
2) Minimise internal heat generation through energy efficient design
3) Manage the heat within the building through exposed internal thermal mass and high ceilings
4) Provide passive ventilation
5) Provide mechanical ventilation
6) Provide active cooling systems

9.3 The proposed development at Stanmore House will benefit from considerable passive solar gains due to its generally favourable orientation, designed to maximise sunlight penetration and reduce overshadowing, which will further reduce the space heating demand of the development. The internal layout of dwellings will be such that wherever practicable the living areas will face south and therefore benefit from a greater amount of solar gain than the rest of the dwelling, which does not have as high a heating demand.

9.4 It is not intended to provide any form of mechanical cooling within the proposed development.

9.5 Passive measures will be taken to ensure that the risk of summer overheating is limited and to improve resilience to the anticipated effect of climate change. Accessible windows will be installed in all dwellings to encourage natural ventilation. A desktop assessment will be undertaken to establish the need and impact of brise solei to the southern elevations of buildings, particularly where main living areas (living room, bedroom) reside. Furthermore, trees and areas of green open space will be provided as part of the development. They facilitate localised cooling through evapotranspiration – the energy which would otherwise heat the local environment is used as latent heat to evaporate water. The deciduous trees will provide shading in the summer and solar gains in the winter.

OVERHEATING RISK ANALYSIS

9.6 The development will be designed to comply with Approved Document Part O Overheating. This will be demonstrated by the completion of a CIBSE TM59 overheating risk assessment for each dwelling.

9.7 Residents will be provided with information on how they can manage their property to mitigate the risk of overheating in accordance with building design features. This will be provided within the Home User Guide/Welcome Pack.

10 RENEWABLE ENERGY (BE GREEN)

10.1 This strategy now considers all renewable technologies that theoretically could be installed at the Stanmore House development.

BIOMASS

10.2 Biomass boilers installed to serve the whole site would require a central energy centre, fuel store and extensive heat distribution network. The costs of this infrastructure would be akin to a CHP installation. Alternatively, individual dwellings could, theoretically, install a biomass boiler and fuel store within the dwelling. However, such an installation is not recommended as the infrastructure requires a whole room within a dwelling, significantly reducing available space for occupants.

WIND TURBINES

10.3 The installation of wind turbines at Stanmore House is theoretically one of the most cost-effective means of generating a substantial fraction of the site's energy demand.

10.4 The British Wind Energy Association (BWEA) generally recommends an average wind speed of at least 7m/s for viable system performance. Sites such as the location of this development are generally unsuitable for wind turbine installations due to the interrupted turbulent wind flows caused by surrounding buildings and mature trees. There are also possible issues with noise and 'flicker' for the neighbouring buildings.

10.5 The nature of the site and low average wind speeds mean that a wind turbine cannot be recommended as a viable option for this development.

HYDRO POWER

10.6 Hydro power installations are not feasible due to the absence of a major watercourse flowing through or adjacent to the development.

GROUND SOURCE HEAT PUMPS

10.7 Ground Source Heat Pumps (GSHPs) takes advantage of the stable ground temperature of 12 degrees Celsius to heat either air or water to provide energy efficient heating (and optional comfort cooling) to a dwelling. The energy flow is driven by the temperature difference between the ground and circulating fluid which can then be used to deliver heating to a dwelling. Elements are laid underground on land adjacent to the dwelling. For properties that are short of space, an alternative to traditional horizontal coils is a vertical installation via boreholes. However, even this type of installation requires boreholes of 100m depth spaced out at 6m intervals, an arrangement which is likely to be unavailable at the proposed development due to space constraints.

10.8 Another concern with GSHPs derives from the efficiency of such systems – although the more efficient heat pumps on the market deliver 90% of a home's heating and hot water needs, an electric immersion back-up system is needed to keep up with winter demand.

AIR SOURCE HEAT PUMPS

10.9 Air Source Heat Pumps (ASHPs) operate similarly to their ground source counterparts and in much the same way as a reverse refrigerator, converting low grade heat from a large 'reservoir' into higher temperature heat for input into a smaller space. Electricity drives the pump which extracts heat from the air as it flows over the coilers in the heat pump unit. A compressor in heat pump upgrades the temperature of the extracted energy which can then be used for space heating and hot water. Unlike GSHPs there is not a requirement for ground works with ASHPs, although the siting of the heat pump unit needs to be carefully considered due to the impact on available space and appearance.

10.10 Overall ASHPs represent the most suitable renewable energy technology for the development as they can provide significant carbon savings compared to 2021 Building Regulations. 2021 Building Regulations and SAP 10 has resulted in electric, or heat pumps derived heating and hot water becoming the standard industry approach for developments moving forward. This is because the carbon factor for grid derived electricity has reduced by 75%.

10.11 ASHPs have the potential to provide greater carbon savings than PV whilst supporting the Governments departure from a reliance on fossil fuels. Gas boilers will eventually become obsolete, thus the installation of ASHPs will future proof the development and avoid costly retrofitting.

SOLAR THERMAL PANELS

10.12 Solar Thermal panels constitute water or glycol circulating to roof level where it is heated using solar energy before being returned to a thermal store where heat is exchanged with water from the conventional system. However, systems of this kind require expensive dual coil water cylinders which demand space within the property and therefore are not considered suitable.

SOLAR PHOTOVOLTAIC

10.13 Solar photovoltaic (PV) panels theoretically represent a suitable renewable energy technology. This is due to their ease of installation, favourable southerly orientation, and capacity for achieving energy savings. However considerable carbon reductions in line with those achieved from the installation of ground or air sourced heat pumps would require a sizable PV unit.

10.14 The carbon savings and electricity generation from PV is weather dependent. Although solar energy can be collected during cloudy and rainy days, the overall efficiency drops. This is because PV is dependent on sunlight to gather solar energy. Therefore, a few cloudy days will have a noticeable effect on the energy system.

10.15 The installation of PV would generate electricity for your lighting and appliances however a separate heating system is still required. The combination of PV and a gas boiler would depart from the Future Homes Standards ambitions, and the intended move away from fossil fuel. This does not future proof the development or give it opportunity to achieve the full carbon saving capacities of heat pump derived heating and hot water. All gas boiler installations will be banned across the UK by 2035, meaning that the homeowner will be faced with a costly retrofit.

10.16 The Applicant is considering the installation of ASHPs to all dwellings.

Technology	Feasible?	Recommended?	Why?
Solar PV	✓	×	A sizable PV unit would be required to achieve the required carbon reductions. Weather dependent and reliant on a separate heating system. Generates less energy overall than heat pumps. Future retrofitting of heating system required.
Solar thermal	✓	×	Similar attributes as per PV but also requires expensive dual coil water cylinders.
Ground Source Heat Pump	×	×	Insufficient land is available for all dwelling types; significant and costly civic work required to install necessary pipework.
Air Source Heat Pump	✓	✓	Sufficient space is available for all dwelling types. Maintains large carbon reductions without compromising the occupant's available space. Supports the move away from fossil fuels.
Micro-CHP	×	×	Suitable in place of a gas boiler but expensive and has high NOx emissions which could create a local air quality management problem.
Biomass	×	×	Requires a plant room, gas boiler back up and space for fuel storage and deliveries. Heat distribution system not economical for a site on this scale.
Hydro	×	×	No available watercourse.
Wind	×	×	Sufficient wind speed available but contentious from a planning perspective; likely to lead to a community 'backlash'. Costly.

Table 9: Renewable Feasibility Summary Table for Stanmore House

10.17 The impact of the recommended ASHPs on the regulated carbon dioxide emissions of the proposed development have been modelled and are shown in table 10 below.

10.18 A sufficiently sized ASHP has been specified within each dwelling to achieve the required savings in regulated carbon dioxide. The SAP 10 output worksheets are provided in Appendix A of this report.

	Carbon dioxide emissions (tonnes CO_2 per annum)	Regulated carbon dioxide savings (%)
Baseline: Part L 2021 of the Building Regulations Compliant Development	5.5	-
After energy demand reductions (be lean)	5.3	4%
After heat network connection (be clean)	4.5	14%
After renewable energy (be green)	2.2	42%
Total carbon dioxide savings (%)		60%

Table 10: Baseline, 'be lean', 'be clean' and 'be green' regulated carbon emissions

10.19 The 'be green' case demonstrates total carbon dioxide emissions of 2.2 tonnes CO_2 per annum. This is a 42% reduction in regulated carbon emissions against the 'be clean' case and a total carbon dioxide saving of 60%, thus meeting the requirements of Cotswold District Local Plan (2011-2031).

10.20 The Applicant has an unequivocal commitment to the exclusion of gas from the development with heating provided by air source heat pumps (ASHPs). The heating systems provided within each development will have a sufficiently sized surface area emitters (such as underfloor heating), low temperatures and seasonal ASHP efficiencies of 300% or more to ensure that the heating systems are economical to run.

11 PART 2: SUSTAINABILITY STATEMENT

11.1 Resi Resolve has carried out a sustainability statement for the proposed development at Stanmore House to satisfy the sustainability requirements of Cotswold District Local Plan (2011-2031).

11.2 The Applicant is committed to making the fullest contribution to promoting sustainability across the development. Consideration has been made to the following areas of design and construction which will be further explored within this statement:

- Maximising use of natural systems
- Conserving energy, materials, and water resources
- Reducing noise and pollution
- Ensuring developments are comfortable and accessible for users
- Conserving and enhancing the natural environment and biodiversity
- Sustainable construction and waste management

12 MAXIMISE USE OF NATURAL SYSTEMS

PRINCIPLES OF GOOD DESIGN

12.1 The Applicants proposed development at Stanmore House maximises the potential of the site and conforms to good design principles for the development. The proposals aim to create a new settlement that reflects the predominant architectural character of the local area.

12.2 The energy demand and carbon dioxide emissions from the proposed dwellings will be minimised through careful design of the built form and services.

CLIMATE CHANGE MITIGATION

12.3 The proposed development at Stanmore House will incorporate a range of measures to mitigate for the anticipated impacts of climate change. Full details on the following measures are provided throughout Part 1 and 2 of this report. In summary:

- Energy conservation and efficiency measures will be taken in the design and construction of the buildings to meet the Part L Building Regulations standard. This will include the specification of robust fabric standards, buildings orientated due south wherever practicable, and the sizing of windows to maximise passive solar gains and ensure adequate daylight.
- Consideration to orientation and configuration of development to avoid contribution to urban heat island effect.
- Energy efficient internal and external lighting throughout the scheme.
- The incorporation of landscaped areas to promote sustainable drainage, urban cooling, and biodiversity enhancement. The creation of landscaping zones will also help to enhance the local microclimate and counter air pollution.
- Deciduous trees which can bring solar shading in summer and promote sunlight penetration in winter are to be incorporated as an aspect of the landscape plan.
- Utilisation of sustainable sanitary features to minimise water consumption across the site.
- The selection of materials for the buildings will be determined with reference to the BRE's Green Guide Specification. Preference will be given to materials with the lowest lifecycle impact for all the main building and finishing elements e.g., PEFC or FSC sourced timber, where viable.

- A detailed drainage strategy will address increases in surface water run-off and the effect of climate change.

13 CONSERVE ENERGY, MATERIAL AND WATER RESOURCES

ENERGY EFFICIENCY AND REDUCED DEMAND

13.1 The assessment of potential methods of conserving energy and the use of energy efficient and renewable energy technologies has been carried out within Part 1 of this statement. The strategic approach to the design of the development has been to reduce carbon dioxide emissions in line with the energy hierarchy.

LOW CARBON AND RENEWABLE ENERGY SYSTEMS

13.2 An array of low carbon and renewable energy technologies have been considered in relation to the proposed development at Stanmore House. These comprise:

- Combined Heat and Power (CHP)
- Biomass
- Ground source heat pumps
- Air source heat pumps
- Solar thermal panels
- Wind turbines
- Solar photovoltaic panels

13.3 It is proposed that ASHPs represents the most viable solution for long term energy efficiency for the Stanmore House development.

MATERIAL PROCUREMENT

13.4 While a major consideration in materials selection is maintaining a distinct architectural style, from a sustainability perspective the Applicant is equally committed to minimising the environmental impact of the materials used over the lifetime of the building – from manufacture to eventual demolition, to disposal. For building materials, the Applicant will, wherever viable and practicable, specify ‘A+ to D’ rated materials using the online BRE Green Guide to Housing Specification.

13.5 Wherever feasible, the Applicant will commit to using materials that are locally sourced, are from renewable sources and are recycled e.g., secondary aggregates. The use of recycled materials (e.g., crushed concrete from waste used for hard standing) has zero embodied energy impact, other than that expended in their processing or transport. Prior to demolition, the ICE's Demolition Protocol will be used to maximise the recycling of materials.

13.6 Timber used in the development for both basic and finishing elements will be sourced from sustainable European sources (e.g., PEFC or FSC).

WATER CONSUMPTION

13.7 The Applicant is committed to reducing water consumption in line Part G of Building Regulations. The internal potable water consumption in all dwellings will be limited to not more than 125 litres per person per day. To meet these targets water efficient sanitary devices will be installed. The specification of such devices will be considered at the detailed design stage, and each will be subject to an evaluation based upon technical performance and market appeal. The following devices will be assessed and, if viable, incorporated within each building unit:

- Spray/aerated/flow restricted taps
- Dual flush toilets
- Low output showers
- Reduced size baths to the point of overflow
- Water efficient white goods

WATER METERING

13.8 The Applicant proposes 100% water metering across the Stanmore House development. This will enable future residents and building occupants to closely monitor their consumption patterns.

RAINWATER HARVESTING FOR IRRIGATION

13.9 Drier summers, increased drought conditions and higher temperatures due to climate change are likely to reduce water supplies across all southern England over the next few decades. Beyond the water efficiency savings detailed above, the Applicant is committed to further reducing mains water use at Stanmore House by incorporating rainwater harvesting facilities, appropriate to the land use, where viable. Water butts will be allocated to residential properties, facilitating the irrigation of soft landscaping without recourse to potable water supplies.

CYCLE STORAGE

13.10 Adequately sized, secure, and convenient cycle storage will be provided to promote the use of bicycles to further reduce the developments carbon footprint. The following provision will be allocated to each dwelling:

- Studios or 1-bedroom dwellings – storage for 1 cycle dwelling
- 2- and 3-bedroom dwellings – storage for 2 cycles per dwelling
- 4 bedrooms and above – storage for 4 cycles per dwelling

ELECTRIC VEHICLE CHARGING FACILITIES

13.11 The development will accommodate active EV charging facilities to all dwellings.

14 REDUCE POLLUTION

NOISE POLLUTION

14.1 The dwellings will be designed using Robust Details to facilitate a considerable enhancement on the acoustic standard required by Part E of Building Regulations. It is predicted that the development will achieve at least a 5dB improvement on the acoustic standards set by Building Regulations.

LIGHT POLLUTION

14.2 All external lighting will be of the dedicated energy efficient type. The lighting will be arranged so that it is all down-facing, and this will reduce the risk of light pollution. Daylight sensors and time controls will also be provided for all external lighting to ensure that it can be automatically switched off when not required.

AIR POLLUTION

14.3 Air intakes/outlets within the proposed buildings will avoid major sources of external pollution to avoid internal air pollution.

14.4 The Applicant will also adopt best practice procedures for minimising air and dust pollution on site. This is likely to take the form of wheel washing facilities and the sheeting of vehicles carrying waste materials off-site if there is any risk of dust blow.

14.5 There will be a negligible increase in road traffic emissions due to the proposed Stanmore House development when considering the surrounding location, and as such will cause an insignificant increase in nitrogen dioxide emissions or increase in particulate matter emissions.

WATER POLLUTION

14.6 During the construction phase, the Applicant will adopt best practice procedures on site in relation to the potential for water pollution. Detailed procedural guidance will be disseminated to site operatives.

LAND AFFECTED BY CONTAMINATION

14.7 The existing site is not used for industrial or commercial purposes and is therefore considered unlikely to be affected by contamination, including:

- soils contaminated by chemicals
- migration of contaminants to ground and surface waters; and
- the production of hazardous gases

14.8 A separate soil investigation report will further amplify proposals and mitigation of any contamination.

POLLUTION FROM BUILDING MATERIALS

14.9 All insulating materials will have an Ozone Depleting Potential of Zero and a Global Warming Potential of less than 5. It is intended that the Stanmore House development will utilise low Volatile Organic Compounds. These are usually solvents that have the capacity to rapidly evaporate. Once airborne they cause chemical or photochemical reactions in the atmosphere leading to the formation of smog containing, amongst other things, ground level ozone and can produce several physical problems such as eye and skin irritation, lung and breathing problems, headaches, nausea, and muscle weakness. Preference will also be given to the specification of inert materials as they are non-toxic and easily re-used or recycled.

14.10 The design of the buildings will avoid the use of CFCs or HCFCs in their insulation, air-conditioning (if installed) and firefighting proposals. Plans will be formulated by the Applicant to avoid sickness, contamination of watercourses/extraction points and other risks to health and safety of people in or around the buildings.

15 FLOOD RISK AND SUSTAINABLE DRAINAGE

15.1 The Applicant will consider all potential options for the incorporation of Sustainable Urban Drainage Systems (SuDS) in line with the Government's Technical Standards.

15.2 The SuDS provision will consider all possibilities to maximise ecological benefits such as incorporating tree planting and landscaping.

15.3 Environment Agency guidelines require that surface water be disposed of by means of a soakaway. All surface water runoff rates post development will be no more than their pre-development counterparts for all storm incidences up to and including the 1 in 100-year event, including an allowance for climate change.

15.4 A Flood Risk Assessment/Drainage Strategy will be prepared by a suitably qualified professional.

16 HEALTH AND WELL-BEING

PRIVATE SPACE

16.1 The Applicant is dedicated to provided adequate external garden space to the dwellings.

16.2 The Applicant is committed to providing appropriate provisions of open space which meet the needs of the development.

COMFORTABLE LIVING

16.3 The internal climate associated with all buildings within the development will be typified by good daylight levels, high levels of insulation to ensure thermal comfort, a high number of openable windows for natural ventilation and an easily understood heating system.

NOISE

16.4 The dwellings will be designed using Robust Details to facilitate a considerable enhancement on the acoustic standard required by Part E of Building Regulations. It is predicted that the development will achieve at least a 5dB improvement on the acoustic standards set by Building Regulations.

HOME OFFICE

16.5 Adequate space allowances and services, such as high-speed internet connections, will be provided to each dwelling to promote home working thus reducing the need to commute.

17 CONSERVE AND ENHANCE THE NATURAL ENVIRONMENT AND BIODIVERSITY

17.1 The Applicant is committed to minimising the impact of the development on the site and the surrounding ecology. Any ecological features defined to have ecological value will be retained and protected during the construction phase.

17.2 The biodiversity and ecology of the site is considered and amplified by a separate report. The report shall investigate potential constraints of development for the site and identify the presence of any protected plant or animal species.

17.3 To mitigate the potential impact of the scheme and to enhance the sites existing biodiversity, where feasible, recommendations from a suitably qualified ecologist will be considered.

18 SUSTAINABLE CONSTRUCTION AND WASTE MANAGEMENT

18.1 The Applicant is committed to identify measures to minimise the generation of waste and to handle waste appropriately during the lifetime of the development.

18.3 The Applicant will adopt best practice procedures and ensure that appropriate measures are taken. For example:

- Appropriate transportation of waste
- Re-use of demolition and building waste
- Re-use and refurbish buildings where possible
- Promoting the use of recycled and secondary aggregates
- Reduce/remove over ordering of building material.

18.4 The Applicant's detailed proposals allocate sufficient space within the proposed bin store for general refuse and recyclable waste bins. All waste containers will be sited on a hard, level surface that is fully accessible to wheelchair users.

18.5 To help encourage and promote domestic recycling, the Applicant will endeavour to provide dwellings, where practical, with three internal waste bins in a kitchen cupboard adjacent to the sink. These will have a total capacity of at least 30 litres and will enable the segregation of various recyclable waste streams. A Home User Guide will be provided to each dwelling will describe the waste services provided by Cotswold District Council. The guide will provide further information as well as guidance on reducing and recycling waste.

18.6 Site waste generated in the construction of the development will be managed to both limit the amount of waste generated and to recycle or re-use any waste that is generated by the development, where possible. National Policy, such as the Landfill Directive, will be followed.

19 CONCLUSION

19.1 This Energy Strategy and Sustainability Statement describes the approach at the proposed Stanmore House development. The described approach will enable the Applicant to create a high standard sustainable development in accordance with the sustainability requirements of Cotswold District Local Plan (2011-2031).

19.2 The proposals within this statement demonstrate a 60% reduction in regulated carbon dioxide emissions of the proposed new dwellings at the Stanmore House development. This exceeds the requirements of Building Regulations 2021 Approved Document Part L. The strategy also adheres to the guidance described with the Net Zero Carbon Toolkit.

19.3 All dwellings will be designed and constructed with the issue of climate change and its anticipated impacts being considered within the Masterplan, which includes appropriate mitigation measures for issues such as preventing internal overheating.

19.4 Cost saving benefits for the future residents and users will occur because of energy efficient and well insulated buildings. This strategy is geared towards reducing energy consumption using highly efficient heat sources, coupled with high levels of insulation, enhanced energy efficient measures and renewable technology such as ASHPs.

19.5 The proposed approach detailed in this Energy Strategy and Sustainability Statement will ensure that the requirements of EN1 and ENE2 of Cotswold District Local Plan (2011-2031) will be met with consideration made to the following areas of design and construction:

- Energy Efficiency Measures
- Sustainable Design and Layout
- Water Resource Management
- Material Resource Management
- Biodiversity
- Sustainable Construction and reducing pollution.

APPENDIX A

Full SAP Calculation Printout

elmhurst energy

Property Reference	MOR/0001/23 B	Issued on Date	24/01/2024
Assessment Reference	BE GREEN	Prop Type Ref	House Type B
Property	Stanmore House, House Type B, Ewen, Cotswold, Gloucestershire, GL7 6BU		

SAP Rating	85 B	DER	2.83	TER	7.01
Environmental	97 A	% DER < TER			59.63
CO_2 Emissions (t/year)	0.69	DFEE	34.33	TFEE	37.85
Compliance Check	See BREL	% DFEE < TFEE			9.28
% DPER < TPER	20.92	DPER	29.46	TPER	37.26

Assessor Details	Mrs. Georgina O'Connor	Assessor ID	T293-0001
Client	MOR, Claudia Jones		

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)			Volume (m3)	
Ground floor	135.3500 (1b)	x	2.6000 (2b)	=	351.9100 (1b) - (3b)		
First floor	119.0300 (1c)	x	2.4000 (2c)	=	285.6720 (1c) - (3c)		
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 254.3800					(4)		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	637.5820 (5)		

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
DOOR			1.8700	1.1000	2.0570			(26)
WINDOW (Uw = 1.30)			37.5000	1.2357	46.3403			(27)
HG DOOR			3.7400	1.3000	4.8620			(26a)
Heatloss Floor 1			135.3500	0.1100	14.8885	75.0000	10151.2500	(28a)
External Wall 1	261.5880	43.1100	218.4780	0.1800	39.3260	60.0000	13108.6800	(29a)
External Roof 1	135.3500		135.3500	0.1100	14.8885	9.0000	1218.1500	(30)
Total net area of external elements Aum(A, m2)			532.2880					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	122.3623			(33)
Internal Floor 1			119.0300			18.0000	2142.5400	(32d)
Internal Ceiling 1			119.0300			9.0000	1071.2700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	27691.8900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		108.8603	(35)
Thermal bridges (User defined value 0.006 * total exposed area)		3.1937	(36)
Point Thermal bridges	(36a) =	0.0000	

Total fabric heat loss (33) + (36) + (36a) = 125.5561 (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	105.2010	105.2010	105.2010	105.2010	105.2010	105.2010	105.2010	105.2010	105.2010	105.2010	105.2010	105.2010	(38)
Heat transfer coeff	230.7571	230.7571	230.7571	230.7571	230.7571	230.7571	230.7571	230.7571	230.7571	230.7571	230.7571	230.7571	(39)
Average = Sum(39)m / 12 =												230.7571	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9071	0.9071	0.9071	0.9071	0.9071	0.9071	0.9071	0.9071	0.9071	0.9071	0.9071	0.9071	(40)
HLP (average)												0.9071	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0726 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	32.6929	32.2074	31.5236	30.2629	29.3190	28.2722	27.7068	28.3858	29.1250	30.2451	31.5317	32.5824	(42b)
Hot water usage for other uses	46.0967	44.4205	42.7443	41.0680	39.3918	37.7155	37.7155	39.3918	41.0680	42.7443	44.4205	46.0967	(42c)
Average daily hot water use (litres/day)												72.2176	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	78.7896	76.6279	74.2679	71.3310	68.7107	65.9877	65.4224	67.7776	70.1931	72.9893	75.9522	78.6791	(44)
Energy conte	124.7835	109.1171	114.1470	97.6485	92.4978	81.1396	79.1227	83.9228	86.5551	99.0458	108.2079	123.1925	(45)
Energy content (annual)											Total = Sum(45)m =	1199.3802	
Distribution loss (46)m = 0.15 x (45)m	18.7175	16.3676	17.1220	14.6473	13.8747	12.1709	11.8684	12.5884	12.9833	14.8569	16.2312	18.4789	(46)

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.3000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7020 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	21.7620	19.6560	21.7620	21.0600	21.7620	21.0600	21.7620	21.7620	21.0600	21.7620	21.0600	21.7620	(56)
If cylinder contains dedicated solar storage	21.7620	19.6560	21.7620	21.0600	21.7620	21.0600	21.7620	21.7620	21.0600	21.7620	21.0600	21.7620	(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	169.8079	149.7843	159.1714	141.2205	137.5222	124.7116	124.1471	128.9472	130.1271	144.0702	151.7799	168.2169	(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	169.8079	149.7843	159.1714	141.2205	137.5222	124.7116	124.1471	128.9472	130.1271	144.0702	151.7799	168.2169	(64)

Total per year (kWh/year) = Sum(64)m = 1729.5062 (64)
12Total per year (kWh/year) 1730 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Electric shower(s)	60.6533	54.0426	59.0124	56.3148	57.3715	54.7269	56.5511	57.3715	56.3148	59.0124	57.9027	60.6533	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 689.9273 (64a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	92.6734	82.3258	88.7265	81.4044	81.1179	75.5182	76.4656	78.2667	77.7159	83.7054	85.3124	92.1443	(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	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	224.8532	248.9447	224.8532	232.3484	224.8532	232.3484	224.8532	224.8532	232.3484	224.8532	232.3484	224.8532	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	420.1768	424.5369	413.5496	390.1588	360.6321	332.8812	314.3419	309.9817	320.9691	344.3599	373.8866	401.6375	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	(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)	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	(71)
Water heating gains (Table 5)	124.5610	122.5087	119.2560	113.0617	109.0295	104.8865	102.7763	105.1972	107.9387	112.5072	118.4894	123.8499	(72)
Total internal gains	838.6804	865.0796	826.7482	804.6582	763.6042	739.2053	711.0608	709.1216	730.3455	750.8097	793.8137	819.4300	(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	10.3100	10.6334	0.4400	0.0000	0.7700	37.1427	(74)
East	8.4200	19.6403	0.4400	0.0000	0.7700	56.0277	(76)
South	13.2900	46.7521	0.4400	0.0000	0.7700	210.5083	(78)
West	5.4800	19.6403	0.4400	0.0000	0.7700	36.4646	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	340.1433	596.6745	857.7496	1124.6626	1310.7983	1322.3498	1266.2404	1125.1115	950.3294	671.0427	410.6715	288.9237	(83)
Total gains	1178.8237	1461.7541	1684.4978	1929.3208	2074.4025	2061.5551	1977.3012	1834.2331	1680.6749	1421.8524	1204.4852	1108.3537	(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	33.3346	33.3346	33.3346	33.3346	33.3346	33.3346	33.3346	33.3346	33.3346	33.3346	33.3346	33.3346	
alpha	3.2223	3.2223	3.2223	3.2223	3.2223	3.2223	3.2223	3.2223	3.2223	3.2223	3.2223	3.2223	
util living area	0.9846	0.9694	0.9424	0.8811	0.7760	0.6246	0.4825	0.5323	0.7421	0.9153	0.9730	0.9873	(86)
Living	19.2339	19.4788	19.8137	20.2270	20.5718	20.7871	20.8665	20.8517	20.6906	20.2231	19.6417	19.1784	
Non living	18.0471	18.3581	18.7812	19.2944	19.7059	19.9422	20.0158	20.0049	19.8474	19.2987	18.5679	17.9763	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	10	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	21	28	2	0	0	0	0	0	0	0	0	31	
MIT	20.3224	20.1385	19.8469	20.2270	20.5718	20.7871	20.8665	20.8517	20.6906	20.2231	19.6417	19.9683	(87)
Th 2	20.1614	20.1614	20.1614	20.1614	20.1614	20.1614	20.1614	20.1614	20.1614	20.1614	20.1614	20.1614	(88)
util rest of house	0.9822	0.9647	0.9335	0.8621	0.7396	0.5635	0.4009	0.4499	0.6890	0.8977	0.9681	0.9853	(89)
MIT 2	19.5292	19.3655	18.8309	19.2944	19.7059	19.9422	20.0158	20.0049	19.8474	19.2987	18.5679	19.1970	(90)
Living area fraction									fLA = Living area / (4) =			0.0967	(91)
MIT	19.6059	19.4402	18.9291	19.3846	19.7896	20.0238	20.0981	20.0867	19.9289	19.3880	18.6717	19.2715	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6059	19.4402	18.9291	19.3846	19.7896	20.0238	20.0981	20.0867	19.9289	19.3880	18.6717	19.2715	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9804	0.9600	0.9169	0.8413	0.7215	0.5527	0.3945	0.4420	0.6724	0.8774	0.9563	0.9828	(94)
Useful gains	1155.7199	1403.2959	1544.5878	1623.1257	1496.6158	1139.4778	779.9520	810.8136	1130.1101	1247.5806	1151.8192	1089.2461	(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	3531.9485	3355.2579	2868.1119	2419.3914	1866.7382	1251.5908	807.2016	850.7387	1345.0550	2027.8985	2670.2515	3477.8620	(97)
Space heating kWh	1767.9141	1311.7184	984.7020	573.3113	275.3711	0.0000	0.0000	0.0000	0.0000	580.5565	1093.2713	1777.1302	(98a)
Space heating requirement - total per year (kWh/year)												8363.9748	
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	1767.9141	1311.7184	984.7020	573.3113	275.3711	0.0000	0.0000	0.0000	0.0000	580.5565	1093.2713	1777.1302	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8363.9748	
Space heating per m2										(98c) / (4) =		32.8798	(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 %)	327.1012	(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	1767.9141	1311.7184	984.7020	573.3113	275.3711	0.0000	0.0000	0.0000	0.0000	580.5565	1093.2713	1777.1302	(98)
Space heating efficiency (main heating system 1)	327.1012	327.1012	327.1012	327.1012	327.1012	0.0000	0.0000	0.0000	0.0000	327.1012	327.1012	327.1012	(210)
Space heating fuel (main heating system)	540.4793	401.0131	301.0390	175.2703	84.1853	0.0000	0.0000	0.0000	0.0000	177.4853	334.2303	543.2968	(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	169.8079	149.7843	159.1714	141.2205	137.5222	124.7116	124.1471	128.9472	130.1271	144.0702	151.7799	168.2169	(64)
Efficiency of water heater												169.4774	(216)
(217)m	169.4774	169.4774	169.4774	169.4774	169.4774	169.4774	169.4774	169.4774	169.4774	169.4774	169.4774	169.4774	(217)
Fuel for water heating, kWh/month	100.1950	88.3801	93.9189	83.3270	81.1449	73.5860	73.2529	76.0852	76.7814	85.0085	89.5576	99.2562	(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	7.2766	6.5724	7.2766	7.0419	7.2766	7.0419	7.2766	7.2766	7.0419	7.2766	7.0419	7.2766	(231)
Lighting	59.7808	47.9584	43.1812	31.6364	24.4369	19.9651	22.2921	28.9762	37.6372	49.3820	55.7769	61.4423	(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	2556.9994	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	169.4774	
Water heating fuel used	1020.4936	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 4.9565, total flow = 45.0000, SFP = 0.1101)		
mechanical ventilation fans (SFP = 0.1101)	85.6759	(230a)
Total electricity for the above, kWh/year	85.6759	(231)
Electricity for lighting (calculated in Appendix L)	482.4657	(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			4835.5619	(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	2556.9994	0.1555	397.6595	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1020.4936	0.1407	143.5825	(264)
Energy for instantaneous electric shower(s)	689.9273	0.1391	95.9842	(264a)
Space and water heating			541.2419	(265)
Pumps, fans and electric keep-hot	85.6759	0.1387	11.8843	(267)
Energy for lighting	482.4657	0.1443	69.6347	(268)
Total CO2, kg/year			718.7451	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.8300	(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	2556.9994	1.5757	4029.1547	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1020.4936	1.5202	1551.3985	(278)
Energy for instantaneous electric shower(s)	689.9273	1.5143	1044.7805	(278a)
Space and water heating			5580.5533	(279)
Pumps, fans and electric keep-hot	85.6759	1.5128	129.6104	(281)
Energy for lighting	482.4657	1.5338	740.0219	(282)
Total Primary energy kWh/year			7494.9662	(286)
Dwelling Primary energy Rate (DPER)			29.4600	(287)

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

---

1. Overall dwelling characteristics

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	135.3500	(1b)	x	2.6000	(2b)	=	351.9100	(1b) - (3b)
First floor	119.0300	(1c)	x	2.4000	(2c)	=	285.6720	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 254.3800								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	637.5820	(5)

---

2. Ventilation rate

---

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0627	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3127	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2658	(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	0.3389	0.3323	0.3256	0.2924	0.2858	0.2525	0.2525	0.2459	0.2658	0.2858	0.2991	0.3123	(22b)
Effective ac	0.5574	0.5552	0.5530	0.5428	0.5408	0.5319	0.5319	0.5302	0.5353	0.5408	0.5447	0.5488	(25)

---

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8700	1.0000	1.8700			(26)
TER Semi-glazed door			3.7400	1.0000	3.7400			(26a)

TER Opening Type (Uw = 1.20)			37.5000	1.1450	42.9389	(27)
Heatloss Floor 1			135.3500	0.1300	17.5955	(28a)
External Wall 1	261.5880	43.1100	218.4780	0.1800	39.3260	(29a)
External Roof 1	135.3500		135.3500	0.1100	14.8885	(30)
Total net area of external elements Aum(A, m2)			532.2880			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	120.3590	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 108.8603 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	29.6800	0.0500	1.4840
E3 Sill	27.0100	0.0500	1.3505
E4 Jamb	71.7000	0.0500	3.5850
E5 Ground floor (normal)	55.5000	0.1600	8.8800
E6 Intermediate floor within a dwelling	48.8700	0.0000	0.0000
E16 Corner (normal)	20.0000	0.0900	1.8000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.0995	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	137.4585	(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	117.2858	116.8165	116.3565	114.1960	113.7918	111.9101	111.9101	111.5617	112.6349	113.7918	114.6096	115.4645	(38)
Heat transfer coeff	254.7442	254.2750	253.8150	251.6545	251.2503	249.3686	249.3686	249.0201	250.0934	251.2503	252.0680	252.9229	(39)
Average = Sum(39)m / 12 =												251.6526	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0014	0.9996	0.9978	0.9893	0.9877	0.9803	0.9803	0.9789	0.9831	0.9877	0.9909	0.9943	(40)
HLP (average)												0.9893	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0726 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	75.7377	74.5995	72.9409	69.7676	67.4257	64.8141	63.3296	64.9756	66.7800	69.5841	72.8256	75.4475	(42a)
Hot water usage for baths	32.6929	32.2074	31.5236	30.2629	29.3190	28.2722	27.7068	28.3858	29.1250	30.2451	31.5317	32.5824	(42b)
Hot water usage for other uses	46.0967	44.4205	42.7443	41.0680	39.3918	37.7155	37.7155	39.3918	41.0680	42.7443	44.4205	46.0967	(42c)
Average daily hot water use (litres/day)												142.0452	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	154.5273	151.2274	147.2088	141.0985	136.1364	130.8018	128.7520	132.7532	136.9730	142.5734	148.7778	154.1266	(44)
Energy conte	244.7335	215.3457	226.2545	193.1568	183.2658	160.8361	155.7144	164.3762	168.9014	193.4708	211.9613	241.3250	(45)
Energy content (annual)										Total = Sum(45)m =		2359.3415	
Distribution loss (46)m = 0.15 x (45)m	36.7100	32.3019	33.9382	28.9735	27.4899	24.1254	23.3572	24.6564	25.3352	29.0206	31.7942	36.1988	(46)

Water storage loss:

Store volume	200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6525	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.8924	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(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	295.6596	261.3435	277.1805	242.4401	234.1919	210.1194	206.6404	215.3022	218.1847	244.3968	261.2446	292.2511	(62)
WWHRS	-34.6241	-30.6218	-32.0654	-26.5514	-24.7450	-21.1745	-19.8477	-21.1060	-21.9079	-25.8270	-29.2589	-33.9829	(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	261.0355	230.7216	245.1151	215.8887	209.4469	188.9449	186.7927	194.1962	196.2768	218.5698	231.9857	258.2682	(64)
								Total per year (kWh/year) = Sum(64)m =				2637.2422	(64)
12Total per year (kWh/year)												2637	(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	122.1148	108.4007	115.9705	103.6513	101.6767	92.9046	92.5159	95.3959	95.5864	105.0699	109.9038	120.9814	(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	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	153.6312	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	224.8532	248.9447	224.8532	232.3484	224.8532	232.3484	224.8532	224.8532	232.3484	224.8532	232.3484	224.8532	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	420.1768	424.5369	413.5496	390.1588	360.6321	332.8812	314.3419	309.9817	320.9691	344.3599	373.8866	401.6375	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	38.3631	(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)	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	-122.9050	(71)
Water heating gains (Table 5)	164.1327	161.3105	155.8743	143.9601	136.6623	129.0342	124.3493	128.2203	132.7588	141.2230	152.6441	162.6095	(72)
Total internal gains	881.2521	906.8815	866.3665	838.5566	794.2370	763.3531	732.6338	732.1447	755.1657	782.5255	830.9684	861.1896	(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	10.3100	10.6334	0.6300	0.7000	0.7700	33.5044	(74)
East	8.4200	19.6403	0.6300	0.7000	0.7700	50.5395	(76)
South	13.2900	46.7521	0.6300	0.7000	0.7700	189.8880	(78)
West	5.4800	19.6403	0.6300	0.7000	0.7700	32.8927	(80)

Solar gains	306.8247	538.2275	773.7291	1014.4968	1182.3997	1192.8196	1142.2064	1014.9018	857.2403	605.3110	370.4443	260.6223	(83)
Total gains	1188.0769	1445.1090	1640.0955	1853.0534	1976.6367	1956.1727	1874.8402	1747.0465	1612.4060	1387.8365	1201.4127	1121.8119	(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	30.1957	30.2515	30.3063	30.5665	30.6157	30.8467	30.8467	30.8898	30.7573	30.6157	30.5163	30.4132	
alpha	3.0130	3.0168	3.0204	3.0378	3.0410	3.0564	3.0564	3.0593	3.0505	3.0410	3.0344	3.0275	
util living area	0.9845	0.9716	0.9498	0.9000	0.8115	0.6723	0.5320	0.5800	0.7781	0.9258	0.9741	0.9869	(86)
MIT	18.5317	18.8463	19.2994	19.8932	20.4110	20.7737	20.9195	20.8933	20.6206	19.9322	19.1260	18.4796	(87)
Th 2	20.0821	20.0837	20.0852	20.0923	20.0936	20.0998	20.0998	20.1009	20.0974	20.0936	20.0909	20.0881	(88)
util rest of house	0.9820	0.9671	0.9415	0.8824	0.7763	0.6084	0.4403	0.4895	0.7252	0.9093	0.9693	0.9848	(89)
MIT 2	17.1519	17.5528	18.1277	18.8741	19.5011	19.9121	20.0510	20.0321	19.7559	18.9347	17.9164	17.0889	(90)
Living area fraction									fLA = Living area / (4) =			0.0967	(91)
MIT	17.2853	17.6778	18.2410	18.9726	19.5890	19.9954	20.1349	20.1154	19.8395	19.0311	18.0333	17.2233	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2853	17.6778	18.2410	18.9726	19.5890	19.9954	20.1349	20.1154	19.8395	19.0311	18.0333	17.2233	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9702	0.9499	0.9186	0.8553	0.7536	0.6002	0.4441	0.4910	0.7077	0.8836	0.9529	0.9744	(94)
Useful gains	1152.6899	1372.6672	1506.5456	1584.9615	1489.5547	1174.0813	832.6961	857.8488	1141.1778	1226.3201	1144.8676	1093.0683	(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	3307.9366	3249.0845	2980.0305	2534.8209	1982.1193	1345.4442	881.5009	925.2001	1435.4016	2118.3122	2755.9334	3293.8969	(97)
Space heating kWh	1603.5035	1260.9524	1096.2728	683.8987	366.4681	0.0000	0.0000	0.0000	0.0000	663.6422	1159.9674	1637.4165	(98a)
Space heating requirement - total per year (kWh/year)												8472.1215	
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	1603.5035	1260.9524	1096.2728	683.8987	366.4681	0.0000	0.0000	0.0000	0.0000	663.6422	1159.9674	1637.4165	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8472.1215	
Space heating per m2										(98c) / (4) =		33.3050	(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	1603.5035	1260.9524	1096.2728	683.8987	366.4681	0.0000	0.0000	0.0000	0.0000	663.6422	1159.9674	1637.4165	(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)	1737.2736	1366.1456	1187.7278	740.9520	397.0402	0.0000	0.0000	0.0000	0.0000	719.0056	1256.7361	1774.0157	(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	261.0355	230.7216	245.1151	215.8887	209.4469	188.9449	186.7927	194.1962	196.2768	218.5698	231.9857	258.2682	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4197	87.2775	87.0069	86.4604	85.3013	79.8000	79.8000	79.8000	79.8000	86.3862	87.1617	87.4562	(217)
Fuel for water heating, kWh/month	298.6003	264.3541	281.7192	249.6967	245.5378	236.7731	234.0761	243.3537	245.9609	253.0147	266.1556	295.3115	(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	46.7201	37.4806	33.7471	24.7246	19.0980	15.6032	17.4218	22.6455	29.4143	38.5931	43.5909	48.0186	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-107.0729	-141.9612	-191.8949	-202.2760	-207.1046	-189.1519	-186.4301	-180.9850	-170.3726	-155.2324	-114.2926	-93.6263	(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	-91.1061	-187.0807	-363.9050	-535.6562	-698.2982	-698.3830	-690.4874	-589.3975	-438.2402	-264.1734	-120.4525	-72.4320	(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	9178.8966	(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	3114.5538	(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)	377.0577	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-6690.0129	(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	6066.4952	(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	9178.8966	0.2100	1927.5683	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3114.5538	0.2100	654.0563	(264)
Space and water heating			2581.6246	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	377.0577	0.1443	54.4211	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1940.4006	0.1360	-263.8685	
PV Unit electricity exported	-4749.6122	0.1265	-600.7767	
Total			-864.6452	(269)
Total CO2, kg/year			1783.3297	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.0100	(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	9178.8966	1.1300	10372.1531	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3114.5538	1.1300	3519.4457	(278)
Space and water heating			13891.5989	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	377.0577	1.5338	578.3436	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1940.4006	1.5027	-2915.7632	
PV Unit electricity exported	-4749.6122	0.4643	-2205.3842	
Total			-5121.1474	(283)
Total Primary energy kWh/year			9478.8960	(286)
Target Primary Energy Rate (TPER)			37.2600	(287)

Full SAP Calculation Printout

elmhurst energy

Property Reference	MOR/0001/23 C	Issued on Date	24/01/2024
Assessment Reference	BE GREEN	Prop Type Ref	House Type C
Property	Stanmore House, House Type C, Ewen, Cotswold, Gloucestershire, GL7 6BU		

SAP Rating	85 B	DER	2.83	TER	7.29
Environmental	97 A	% DER < TER			61.18
CO_2 Emissions (t/year)	0.71	DFEE	34.80	TFEE	38.25
Compliance Check	See BREL	% DFEE < TFEE			9.02
% DPER < TPER	23.58	DPER	29.54	TPER	38.66

Assessor Details	Mrs. Georgina O'Connor	Assessor ID	T293-0001
Client	MOR, Claudia Jones		

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	129.5100 (1b)	x	2.6000 (2b)	=	336.7260	(1b) - (3b)
First floor	129.5100 (1c)	x	2.4000 (2c)	=	310.8240	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 259.0200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	647.5500	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
DOOR			2.1200	1.1000	2.3320			(26)
WINDOW (Uw = 1.30)			36.1800	1.2357	44.7091			(27)
HG DOOR			4.2400	1.3000	5.5120			(26a)
Heatloss Floor 1			129.5100	0.1100	14.2461	75.0000	9713.2500	(28a)
External Wall 1	287.1000	42.5400	244.5600	0.1800	44.0208	60.0000	14673.6000	(29a)
External Roof 1	129.5100		129.5100	0.1100	14.2461	9.0000	1165.5900	(30)
Total net area of external elements Aum(A, m2)			546.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		125.0661			(33)
Internal Floor 1			129.5100			18.0000	2331.1800	(32d)
Internal Ceiling 1			129.5100			9.0000	1165.5900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	29049.2100	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		112.1505	(35)
Thermal bridges (User defined value 0.006 * total exposed area)		3.2767	(36)
Point Thermal bridges	(36a) =	0.0000	

Total fabric heat loss (33) + (36) + (36a) = 128.3428 (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	106.8457	106.8457	106.8457	106.8457	106.8457	106.8457	106.8457	106.8457	106.8457	106.8457	106.8457	106.8457	(38)
Heat transfer coeff	235.1886	235.1886	235.1886	235.1886	235.1886	235.1886	235.1886	235.1886	235.1886	235.1886	235.1886	235.1886	(39)
Average = Sum(39)m / 12 =												235.1886	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9080	0.9080	0.9080	0.9080	0.9080	0.9080	0.9080	0.9080	0.9080	0.9080	0.9080	0.9080	(40)
HLP (average)												0.9080	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0787 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	32.7364	32.2502	31.5656	30.3032	29.3580	28.3098	27.7437	28.4236	29.1638	30.2853	31.5737	32.6257	(42b)
Hot water usage for other uses	46.1585	44.4800	42.8015	41.1230	39.4446	37.7661	37.7661	39.4446	41.1230	42.8015	44.4800	46.1585	(42c)
Average daily hot water use (litres/day)												72.3141	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	78.8949	76.7302	74.3671	71.4262	68.8025	66.0759	65.5098	67.8681	70.2868	73.0869	76.0537	78.7842	(44)
Energy conte	124.9503	109.2628	114.2995	97.7790	92.6214	81.2480	79.2284	84.0349	86.6707	99.1782	108.3524	123.3571	(45)
Energy content (annual)										Total = Sum(45)m =		1200.9826	
Distribution loss (46)m = 0.15 x (45)m	18.7425	16.3894	17.1449	14.6668	13.8932	12.1872	11.8843	12.6052	13.0006	14.8767	16.2529	18.5036	(46)

Water storage loss:

Store volume 200.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7020 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	21.7620	19.6560	21.7620	21.0600	21.7620	21.0600	21.7620	21.7620	21.0600	21.7620	21.0600	21.7620	(56)
If cylinder contains dedicated solar storage	21.7620	19.6560	21.7620	21.0600	21.7620	21.0600	21.7620	21.7620	21.0600	21.7620	21.0600	21.7620	(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	169.9747	149.9300	159.3239	141.3510	137.6458	124.8200	124.2528	129.0593	130.2427	144.2026	151.9244	168.3815	(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	169.9747	149.9300	159.3239	141.3510	137.6458	124.8200	124.2528	129.0593	130.2427	144.2026	151.9244	168.3815	(64)
								Total per year (kWh/year) = Sum(64)m =				1731.1086	(64)
12Total per year (kWh/year)												1731	(64)
Electric shower(s)	60.7343	54.1147	59.0912	56.3900	57.4482	54.8000	56.6266	57.4482	56.3900	59.0912	57.9801	60.7343	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							690.8486	(64a)
Heat gains from water heating, kWh/month	92.7490	82.3923	88.7969	81.4666	81.1782	75.5726	76.5196	78.3232	77.7731	83.7691	85.3798	92.2193	(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	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	229.6349	254.2386	229.6349	237.2894	229.6349	237.2894	229.6349	229.6349	237.2894	229.6349	237.2894	229.6349	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	424.1644	428.5659	417.4743	393.8615	364.0546	336.0403	317.3251	312.9236	324.0152	347.6280	377.4349	405.4492	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	(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)	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	(71)
Water heating gains (Table 5)	124.6627	122.6076	119.3507	113.1481	109.1105	104.9619	102.8489	105.2731	108.0182	112.5928	118.5831	123.9507	(72)
Total internal gains	847.6418	874.5920	835.6397	813.4788	771.9798	747.4714	718.9887	717.0114	738.5026	759.0355	802.4872	828.2146	(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	11.2600	10.6334	0.4400	0.0000	0.7700	40.5652	(74)
East	4.6100	19.6403	0.4400	0.0000	0.7700	30.6755	(76)
South	13.6700	46.7521	0.4400	0.0000	0.7700	216.5273	(78)
West	6.6400	19.6403	0.4400	0.0000	0.7700	44.1834	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	331.9514	578.5780	824.6125	1073.8555	1248.0984	1258.3852	1205.2256	1072.6832	910.7392	648.5298	400.0413	282.4770	(83)
Total gains	1179.5932	1453.1700	1660.2521	1887.3343	2020.0782	2005.8566	1924.2143	1789.6946	1649.2418	1407.5653	1202.5285	1110.6916	(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	34.3096	34.3096	34.3096	34.3096	34.3096	34.3096	34.3096	34.3096	34.3096	34.3096	34.3096	34.3096	
alpha	3.2873	3.2873	3.2873	3.2873	3.2873	3.2873	3.2873	3.2873	3.2873	3.2873	3.2873	3.2873	
util living area	0.9865	0.9731	0.9495	0.8946	0.7963	0.6475	0.5030	0.5528	0.7605	0.9238	0.9761	0.9889	(86)
Living	19.2566	19.4903	19.8119	20.2156	20.5610	20.7832	20.8665	20.8512	20.6864	20.2226	19.6557	19.2036	
Non living	18.0729	18.3700	18.7769	19.2797	19.6939	19.9389	20.0164	20.0051	19.8433	19.2966	18.5828	18.0052	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	11	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	20	28	5	0	0	0	0	0	0	0	0	31	
MIT	20.3630	20.1450	19.8950	20.2156	20.5610	20.7832	20.8665	20.8512	20.6864	20.2226	19.6557	19.9826	(87)
Th 2	20.1607	20.1607	20.1607	20.1607	20.1607	20.1607	20.1607	20.1607	20.1607	20.1607	20.1607	20.1607	(88)
util rest of house	0.9844	0.9689	0.9414	0.8768	0.7609	0.5858	0.4188	0.4683	0.7081	0.9074	0.9716	0.9871	(89)
MIT 2	19.5662	19.3703	18.9016	19.2797	19.6939	19.9389	20.0164	20.0051	19.8433	19.2966	18.5828	19.2093	(90)
Living area fraction									fLA = Living area / (4) =			0.0995	(91)
MIT	19.6454	19.4474	19.0004	19.3727	19.7801	20.0229	20.1010	20.0893	19.9272	19.3887	18.6895	19.2862	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6454	19.4474	19.0004	19.3727	19.7801	20.0229	20.1010	20.0893	19.9272	19.3887	18.6895	19.2862	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9828	0.9646	0.9272	0.8569	0.7428	0.5748	0.4125	0.4606	0.6915	0.8883	0.9609	0.9848	(94)
Useful gains	1159.3194	1401.7796	1539.3753	1617.2072	1500.5336	1153.0070	793.6855	824.3557	1140.4448	1250.3017	1155.5055	1093.8107	(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	3609.0687	3421.3768	2939.9504	2463.0679	1900.3530	1275.4011	823.3862	867.6719	1370.4819	2067.0066	2725.7224	3548.1097	(97)
Space heating kWh	1822.6135	1357.1694	1042.0279	609.0197	297.4657	0.0000	0.0000	0.0000	0.0000	607.6284	1130.5561	1825.9984	(98a)
Space heating requirement - total per year (kWh/year)												8692.4791	
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	1822.6135	1357.1694	1042.0279	609.0197	297.4657	0.0000	0.0000	0.0000	0.0000	607.6284	1130.5561	1825.9984	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8692.4791	
Space heating per m2											(98c) / (4) =	33.5591	(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 %)	328.8008	(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	1822.6135	1357.1694	1042.0279	609.0197	297.4657	0.0000	0.0000	0.0000	0.0000	607.6284	1130.5561	1825.9984	(98)
Space heating efficiency (main heating system 1)	328.8008	328.8008	328.8008	328.8008	328.8008	0.0000	0.0000	0.0000	0.0000	328.8008	328.8008	328.8008	(210)
Space heating fuel (main heating system)	554.3215	412.7634	316.9177	185.2245	90.4699	0.0000	0.0000	0.0000	0.0000	184.8014	343.8423	555.3510	(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	169.9747	149.9300	159.3239	141.3510	137.6458	124.8200	124.2528	129.0593	130.2427	144.2026	151.9244	168.3815	(64)
Efficiency of water heater												169.4993	(216)
(217)m	169.4993	169.4993	169.4993	169.4993	169.4993	169.4993	169.4993	169.4993	169.4993	169.4993	169.4993	169.4993	(217)
Fuel for water heating, kWh/month	100.2804	88.4547	93.9968	83.3932	81.2073	73.6404	73.3058	76.1415	76.8397	85.0756	89.6313	99.3405	(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	7.3903	6.6751	7.3903	7.1519	7.3903	7.1519	7.3903	7.3903	7.1519	7.3903	7.1519	7.3903	(231)
Lighting	61.1850	49.0849	44.1955	32.3795	25.0109	20.4341	22.8157	29.6568	38.5212	50.5419	57.0870	62.8855	(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	2643.6917	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	169.4993	
Water heating fuel used	1021.3072	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 4.9565, total flow = 45.0000, SFP = 0.1101)		
mechanical ventilation fans (SFP = 0.1101)	87.0153	(230a)
Total electricity for the above, kWh/year	87.0153	(231)
Electricity for lighting (calculated in Appendix L)	493.7980	(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	4936.6608	(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	2643.6917	0.1554	410.8895	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1021.3072	0.1407	143.6978	(264)
Energy for instantaneous electric shower(s)	690.8486	0.1391	96.1123	(264a)
Space and water heating			554.5872	(265)
Pumps, fans and electric keep-hot	87.0153	0.1387	12.0701	(267)
Energy for lighting	493.7980	0.1443	71.2703	(268)
Total CO2, kg/year			734.0400	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.8300	(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	2643.6917	1.5754	4164.8349	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1021.3072	1.5202	1552.6385	(278)
Energy for instantaneous electric shower(s)	690.8486	1.5143	1046.1757	(278a)
Space and water heating			5717.4734	(279)
Pumps, fans and electric keep-hot	87.0153	1.5128	131.6368	(281)
Energy for lighting	493.7980	1.5338	757.4038	(282)
Total Primary energy kWh/year			7652.6897	(286)
Dwelling Primary energy Rate (DPER)			29.5400	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)			Volume (m3)	
Ground floor	129.5100 (1b)	x	2.6000 (2b)	=		336.7260	(1b) - (3b)
First floor	129.5100 (1c)	x	2.4000 (2c)	=		310.8240	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 259.0200							(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =			647.5500	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0618	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3118	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2650	(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	0.3379	0.3313	0.3246	0.2915	0.2849	0.2518	0.2518	0.2451	0.2650	0.2849	0.2981	0.3114	(22b)
Effective ac	0.5571	0.5549	0.5527	0.5425	0.5406	0.5317	0.5317	0.5300	0.5351	0.5406	0.5444	0.5485	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1200	1.0000	2.1200			(26)
TER Semi-glazed door			4.2400	1.0000	4.2400			(26a)

TER Opening Type (Uw = 1.20)			36.1800	1.1450	41.4275	(27)
Heatloss Floor 1			129.5100	0.1300	16.8363	(28a)
External Wall 1	287.1000	42.5400	244.5600	0.1800	44.0208	(29a)
External Roof 1	129.5100		129.5100	0.1100	14.2461	(30)
Total net area of external elements Aum(A, m2)			546.1200			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	122.8907	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 112.1505 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	29.8100	0.0500	1.4905
E3 Sill	26.7800	0.0500	1.3390
E4 Jamb	64.8000	0.0500	3.2400
E5 Ground floor (normal)	57.4200	0.1600	9.1872
E6 Intermediate floor within a dwelling	57.4200	0.0000	0.0000
E16 Corner (normal)	20.0000	0.0900	1.8000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.0567	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	139.9474	(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	119.0437	118.5701	118.1058	115.9251	115.5171	113.6177	113.6177	113.2660	114.3493	115.5171	116.3424	117.2054	(38)
Heat transfer coeff	258.9911	258.5174	258.0532	255.8724	255.4644	253.5651	253.5651	253.2134	254.2967	255.4644	256.2898	257.1527	(39)
Average = Sum(39)m / 12 =												255.8705	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9999	0.9981	0.9963	0.9878	0.9863	0.9789	0.9789	0.9776	0.9818	0.9863	0.9895	0.9928	(40)
HLP (average)												0.9878	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0787 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	75.8388	74.6991	73.0383	69.8607	67.5157	64.9006	63.4142	65.0624	66.8691	69.6770	72.9228	75.5483	(42a)
Hot water usage for baths	32.7364	32.2502	31.5656	30.3032	29.3580	28.3098	27.7437	28.4236	29.1638	30.2853	31.5737	32.6257	(42b)
Hot water usage for other uses	46.1585	44.4800	42.8015	41.1230	39.4446	37.7661	37.7661	39.4446	41.1230	42.8015	44.4800	46.1585	(42c)
Average daily hot water use (litres/day)												142.2349	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	154.7337	151.4294	147.4054	141.2870	136.3182	130.9765	128.9239	132.9305	137.1560	142.7638	148.9765	154.3325	(44)
Energy conte	245.0604	215.6334	226.5567	193.4148	183.5106	161.0509	155.9223	164.5957	169.1270	193.7292	212.2444	241.6474	(45)
Energy content (annual)										Total = Sum(45)m =		2362.4928	
Distribution loss (46)m = 0.15 x (45)m	36.7591	32.3450	33.9835	29.0122	27.5266	24.1576	23.3884	24.6894	25.3691	29.0594	31.8367	36.2471	(46)

Water storage loss:

Store volume	200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6525	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.8924	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(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	295.9865	261.6311	277.4827	242.6981	234.4366	210.3342	206.8484	215.5218	218.4103	244.6553	261.5277	292.5735	(62)
WWHRS	-34.6703	-30.6627	-32.1082	-26.5869	-24.7780	-21.2027	-19.8742	-21.1342	-21.9372	-25.8615	-29.2980	-34.0283	(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	261.3161	230.9684	245.3745	216.1112	209.6586	189.1315	186.9742	194.3876	196.4732	218.7937	232.2298	258.5452	(64)
								Total per year (kWh/year) = Sum(64)m =				2639.9639	(64)
12Total per year (kWh/year)												2640	(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	122.2234	108.4963	116.0709	103.7371	101.7581	92.9761	92.5850	95.4689	95.6614	105.1558	109.9979	121.0886	(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	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	153.9328	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	229.6349	254.2386	229.6349	237.2894	229.6349	237.2894	229.6349	229.6349	237.2894	229.6349	237.2894	229.6349	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	424.1644	428.5659	417.4743	393.8615	364.0546	336.0403	317.3251	312.9236	324.0152	347.6280	377.4349	405.4492	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	38.3933	(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)	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	-123.1462	(71)
Water heating gains (Table 5)	164.2788	161.4528	156.0093	144.0793	136.7717	129.1334	124.4423	128.3185	132.8630	141.3385	152.7749	162.7535	(72)
Total internal gains	890.2580	916.4372	875.2983	847.4100	802.6410	771.6430	740.5820	740.0568	763.3474	790.7812	839.6790	870.0174	(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	11.2600	10.6334	0.6300	0.7000	0.7700	36.5917	(74)
East	4.6100	19.6403	0.6300	0.7000	0.7700	27.6707	(76)
South	13.6700	46.7521	0.6300	0.7000	0.7700	195.3175	(78)
West	6.6400	19.6403	0.6300	0.7000	0.7700	39.8554	(80)

Solar gains	299.4352	521.9036	743.8379	968.6665	1125.8415	1135.1206	1087.1683	967.6090	821.5281	585.0034	360.8555	254.8071	(83)
Total gains	1189.6932	1438.3408	1619.1363	1816.0764	1928.4825	1906.7636	1827.7503	1707.6658	1584.8756	1375.7845	1200.5344	1124.8245	(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	31.1564	31.2135	31.2696	31.5361	31.5865	31.8231	31.8231	31.8673	31.7315	31.5865	31.4848	31.3791	
alpha	3.0771	3.0809	3.0846	3.1024	3.1058	3.1215	3.1215	3.1245	3.1154	3.1058	3.0990	3.0919	
util living area	0.9863	0.9749	0.9557	0.9110	0.8288	0.6933	0.5518	0.5994	0.7941	0.9331	0.9769	0.9884	(86)
MIT	18.5699	18.8707	19.3060	19.8839	20.3977	20.7663	20.9168	20.8903	20.6151	19.9364	19.1510	18.5203	(87)
Th 2	20.0834	20.0850	20.0864	20.0935	20.0948	20.1009	20.1009	20.1021	20.0986	20.0948	20.0921	20.0893	(88)
util rest of house	0.9840	0.9708	0.9481	0.8947	0.7950	0.6293	0.4581	0.5074	0.7423	0.9176	0.9725	0.9865	(89)
MIT 2	17.1973	17.5810	18.1341	18.8624	19.4871	19.9068	20.0506	20.0314	19.7512	18.9386	17.9453	17.1375	(90)
Living area fraction									fLA = Living area / (4) =			0.0995	(91)
MIT	17.3338	17.7093	18.2507	18.9640	19.5776	19.9923	20.1368	20.1168	19.8372	19.0379	18.0652	17.2750	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3338	17.7093	18.2507	18.9640	19.5776	19.9923	20.1368	20.1168	19.8372	19.0379	18.0652	17.2750	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9735	0.9552	0.9271	0.8690	0.7723	0.6208	0.4621	0.5091	0.7248	0.8934	0.9577	0.9772	(94)
Useful gains	1158.1239	1373.8726	1501.1006	1578.1066	1489.3895	1183.6824	844.5379	869.3298	1148.7447	1229.1906	1149.6944	1099.1925	(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	3375.6427	3311.4189	3032.2985	2575.0969	2012.4527	1367.2870	896.7989	941.1465	1458.9390	2155.5713	2810.2618	3362.2793	(97)
Space heating kWh	1649.8340	1302.0311	1139.2112	717.8330	389.1591	0.0000	0.0000	0.0000	0.0000	689.2272	1195.6085	1683.7366	(98a)
Space heating requirement - total per year (kWh/year)												8766.6407	
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	1649.8340	1302.0311	1139.2112	717.8330	389.1591	0.0000	0.0000	0.0000	0.0000	689.2272	1195.6085	1683.7366	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8766.6407	
Space heating per m2											(98c) / (4) =	33.8454	(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	1649.8340	1302.0311	1139.2112	717.8330	389.1591	0.0000	0.0000	0.0000	0.0000	689.2272	1195.6085	1683.7366	(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)	1787.4691	1410.6512	1234.2483	777.7173	421.6241	0.0000	0.0000	0.0000	0.0000	746.7251	1295.3505	1824.2000	(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	261.3161	230.9684	245.3745	216.1112	209.6586	189.1315	186.9742	194.3876	196.4732	218.7937	232.2298	258.5452	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4514	87.3163	87.0599	86.5415	85.4267	79.8000	79.8000	79.8000	79.8000	86.4507	87.2005	87.4866	(217)
Fuel for water heating, kWh/month	298.8129	264.5192	281.8455	249.7197	245.4251	237.0069	234.3035	243.5935	246.2070	253.0851	266.3171	295.5255	(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	47.7136	38.2776	34.4647	25.2504	19.5041	15.9350	17.7923	23.1271	30.0398	39.4139	44.5179	49.0397	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-104.1883	-138.9806	-188.9934	-200.4468	-206.2153	-188.6871	-185.9889	-180.0914	-168.7529	-152.6101	-111.5306	-90.9993	(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	-85.4398	-175.8641	-342.8253	-505.6455	-660.1217	-660.5530	-653.0919	-557.0511	-413.5997	-248.6994	-113.0859	-67.8939	(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	9497.9856	(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	3116.3611	(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)	385.0760	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-6401.3562	(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	6684.0665	(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	9497.9856	0.2100	1994.5770	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3116.3611	0.2100	654.4358	(264)
Space and water heating			2649.0128	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	385.0760	0.1443	55.5784	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1917.4848	0.1359	-260.4942	
PV Unit electricity exported	-4483.8714	0.1264	-566.8862	
Total			-827.3804	(269)
Total CO2, kg/year			1889.1400	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.2900	(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	9497.9856	1.1300	10732.7238	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3116.3611	1.1300	3521.4880	(278)
Space and water heating			14254.2118	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	385.0760	1.5338	590.6424	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1917.4848	1.5022	-2880.3611	
PV Unit electricity exported	-4483.8714	0.4641	-2080.9639	
Total			-4961.3249	(283)
Total Primary energy kWh/year			10013.6301	(286)
Target Primary Energy Rate (TPER)			38.6600	(287)

Full SAP Calculation Printout

elmhurst energy

Property Reference	MOR/0001/23 D	Issued on Date	24/01/2024
Assessment Reference	BE GREEN	Prop Type Ref	House Type D
Property	Stanmore House, House Type D, Ewen, Cotswold, Gloucestershire, GL7 6BU		

SAP Rating	85 B	DER	2.68	TER	6.68
Environmental	97 A	% DER < TER			59.88
CO_2 Emissions (t/year)	0.69	DFEE	32.95	TFEE	35.92
Compliance Check	See BREL	% DFEE < TFEE			8.27
% DPER < TPER	21.11	DPER	27.91	TPER	35.38

Assessor Details	Mrs. Georgina O'Connor	Assessor ID	T293-0001
Client	MOR, Claudia Jones		

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

1. Overall dwelling characteristics

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	132.8000	(1b)	x	2.4000	(2b)	=	318.7200	(1b) - (3b)
First floor	134.8800	(1c)	x	2.6000	(2c)	=	350.6880	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	267.6800							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	669.4080	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
DOOR			1.9100	1.1000	2.1010			(26)
WINDOW (Uw = 1.30)			44.9900	1.2357	55.5960			(27)
HG DOOR			1.9100	1.3000	2.4830			(26a)
Heatloss Floor 1			132.8000	0.1100	14.6080	75.0000	9960.0000	(28a)
Heatloss Floor 2			37.4600	0.1500	5.6190	20.0000	749.2000	(28b)
External Wall 1	278.9740	48.8100	230.1640	0.1800	41.4295	60.0000	13809.8400	(29a)
External Roof 1	134.8800		134.8800	0.1100	14.8368	9.0000	1213.9200	(30)
Total net area of external elements Aum(A, m2)			584.1140					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	136.6733			(33)
Internal Floor 1			97.9700			18.0000	1763.4600	(32d)
Internal Ceiling 1			97.9700			9.0000	881.7300	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28378.1500	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		106.0152	(35)
Thermal bridges (User defined value 0.006 * total exposed area)		3.5047	(36)

Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	140.1780 (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	110.4523	110.4523	110.4523	110.4523	110.4523	110.4523	110.4523	110.4523	110.4523	110.4523	110.4523	110.4523	(38)
Heat transfer coeff	250.6303	250.6303	250.6303	250.6303	250.6303	250.6303	250.6303	250.6303	250.6303	250.6303	250.6303	250.6303	(39)
Average = Sum(39)m / 12 =												250.6303	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9363	0.9363	0.9363	0.9363	0.9363	0.9363	0.9363	0.9363	0.9363	0.9363	0.9363	0.9363	(40)
HLP (average)												0.9363	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

----

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												3.0899	(42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	32.8176	32.3302	31.6438	30.3783	29.4308	28.3800	27.8125	28.4940	29.2361	30.3604	31.6520	32.7066	(42b)
Hot water usage for other uses	46.2738	44.5911	42.9084	41.2258	39.5431	37.8604	37.8604	39.5431	41.2258	42.9084	44.5911	46.2738	(42c)
Average daily hot water use (litres/day)												72.4942	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	79.0914	76.9213	74.5523	71.6041	68.9738	66.2404	65.6729	68.0371	70.4619	73.2689	76.2431	78.9804	(44)
Energy conte	125.2614	109.5349	114.5841	98.0224	92.8520	81.4503	79.4257	84.2441	86.8865	99.4251	108.6223	123.6643	(45)
Energy content (annual)										Total = Sum(45)m =		1203.9732	
Distribution loss (46)m = 0.15 x (45)m	18.7892	16.4302	17.1876	14.7034	13.9278	12.2175	11.9138	12.6366	13.0330	14.9138	16.2933	18.5496	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7020	(55)
Total storage loss	21.7620	19.6560	21.7620	21.0600	21.7620	21.0600	21.7620	21.7620	21.0600	21.7620	21.0600	21.7620	(56)
If cylinder contains dedicated solar storage	21.7620	19.6560	21.7620	21.0600	21.7620	21.0600	21.7620	21.7620	21.0600	21.7620	21.0600	21.7620	(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	170.2858	150.2021	159.6085	141.5944	137.8764	125.0223	124.4501	129.2685	130.4585	144.4495	152.1943	168.6887	(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	170.2858	150.2021	159.6085	141.5944	137.8764	125.0223	124.4501	129.2685	130.4585	144.4495	152.1943	168.6887	(64)
								Total per year (kWh/year) = Sum(64)m =				1734.0992	(64)
12Total per year (kWh/year)												1734	(64)
Electric shower(s)	60.8854	54.2494	59.2383	56.5304	57.5911	54.9364	56.7676	57.5911	56.5304	59.2383	58.1244	60.8854	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							692.5682	(64a)
Heat gains from water heating, kWh/month	92.8903	82.5165	88.9283	81.5827	81.2906	75.6739	76.6204	78.4285	77.8800	83.8880	85.5056	92.3592	(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	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	224.9535	249.0556	224.9535	232.4519	224.9535	232.4519	224.9535	224.9535	232.4519	224.9535	232.4519	224.9535	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	431.5333	436.0113	424.7270	400.7040	370.3792	341.8783	322.8379	318.3599	329.6443	353.6673	383.9920	412.4929	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	(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)	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	(71)
Water heating gains (Table 5)	124.8525	122.7924	119.5273	113.3092	109.2616	105.1027	102.9845	105.4146	108.1666	112.7526	118.7578	124.1388	(72)
Total internal gains	850.6880	877.2080	838.5564	815.8138	773.9430	748.7816	720.1245	718.0767	739.6115	760.7220	804.5504	830.9339	(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	5.6500	10.6334	0.4400	0.0000	0.7700	20.3547	(74)
East	0.5800	19.6403	0.4400	0.0000	0.7700	3.8594	(76)
South	32.6700	46.7521	0.4400	0.0000	0.7700	517.4797	(78)
West	6.0900	19.6403	0.4400	0.0000	0.7700	40.5236	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	582.2174	973.2198	1288.6456	1534.8455	1670.0503	1638.3361	1587.5584	1488.3938	1373.4993	1063.4328	693.8404	500.6172	(83)
Total gains	1432.9054	1850.4277	2127.2020	2350.6594	2443.9933	2387.1177	2307.6829	2206.4705	2113.1107	1824.1548	1498.3908	1331.5510	(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          31.4520    31.4520    31.4520    31.4520    31.4520    31.4520    31.4520    31.4520    31.4520    31.4520    31.4520    31.4520
alpha         3.0968     3.0968     3.0968     3.0968     3.0968     3.0968     3.0968     3.0968     3.0968     3.0968     3.0968     3.0968
util living area
              0.9759     0.9495     0.9111     0.8423     0.7377     0.5919     0.4512     0.4866     0.6757     0.8706     0.9569     0.9805 (86)

Living       19.2457    19.5479    19.8936    20.2756    20.5873    20.7873    20.8643    20.8537    20.7217    20.2960    19.6834    19.1757
Non living   18.0466    18.4283    18.8615    19.3311    19.6994    19.9169    19.9875    19.9796    19.8534    19.3652    18.6038    17.9577
24 / 16            0          0          0          0          0          0          0          0          0          0          0          0
24 / 9            15          0          0          0          0          0          0          0          0          0          0          0
16 / 9            16         28         18          0          0          0          0          0          0          0          0         31
MIT          20.4872    20.1776    20.1722    20.2756    20.5873    20.7873    20.8643    20.8537    20.7217    20.2960    19.6834    19.9667 (87)
Th 2         20.1367    20.1367    20.1367    20.1367    20.1367    20.1367    20.1367    20.1367    20.1367    20.1367    20.1367    20.1367 (88)
util rest of house
              0.9723     0.9424     0.8985     0.8194     0.6987     0.5304     0.3716     0.4067     0.6191     0.8468     0.9495     0.9775 (89)
MIT 2        19.6606    19.3827    19.2751    19.3311    19.6994    19.9169    19.9875    19.9796    19.8534    19.3652    18.6038    19.1749 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.1381 (91)
MIT          19.7747    19.4924    19.3990    19.4615    19.8220    20.0371    20.1086    20.1003    19.9733    19.4937    18.7528    19.2843 (92)
Temperature adjustment                                                                                                       0.0000
adjusted MIT     19.7747    19.4924    19.3990    19.4615    19.8220    20.0371    20.1086    20.1003    19.9733    19.4937    18.7528    19.2843 (93)
```

```
-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation       0.9706     0.9362     0.8859     0.7988     0.6830     0.5229     0.3689     0.4032     0.6073     0.8257     0.9341     0.9741 (94)
Useful gains   1390.8164  1732.3339  1884.4861  1877.6451  1669.3496  1248.1283   851.3855   889.6195  1283.3375  1506.1655  1399.6043  1297.0043 (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
               3878.4337  3657.3016  3232.8757  2647.0388  2035.6226  1362.6920   879.3519   927.4111  1472.0159  2229.0338  2920.5557  3780.5757 (97)
Space heating kWh
               1850.7873  1293.5783  1003.2019   553.9635   272.5072     0.0000     0.0000     0.0000     0.0000   537.8141  1095.0851  1847.7771 (98a)
Space heating requirement - total per year (kWh/year)                                                                       8454.7144
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
               1850.7873  1293.5783  1003.2019   553.9635   272.5072     0.0000     0.0000     0.0000     0.0000   537.8141  1095.0851  1847.7771 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                              8454.7144
Space heating per m2                                                                                   (98c) / (4) =     31.5852 (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 %)                                                                             334.3749 (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
               1850.7873  1293.5783  1003.2019   553.9635   272.5072     0.0000     0.0000     0.0000     0.0000   537.8141  1095.0851  1847.7771 (98)
Space heating efficiency (main heating system 1)
                334.3749   334.3749   334.3749   334.3749   334.3749     0.0000     0.0000     0.0000     0.0000   334.3749   334.3749   334.3749 (210)
Space heating fuel (main heating system)
                553.5067   386.8647   300.0231   165.6714    81.4975     0.0000     0.0000     0.0000     0.0000   160.8417   327.5022   552.6065 (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
                170.2858   150.2021   159.6085   141.5944   137.8764   125.0223   124.4501   129.2685   130.4585   144.4495   152.1943   168.6887 (64)
Efficiency of water heater                                                                                                   169.5696 (216)
(217)m          169.5696   169.5696   169.5696   169.5696   169.5696   169.5696   169.5696   169.5696   169.5696   169.5696   169.5696   169.5696 (217)
Fuel for water heating, kWh/month
                100.4224    88.5785    94.1257    83.5023    81.3097    73.7292    73.3917    76.2333    76.9351    85.1860    89.7533    99.4805 (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      7.6398     6.9005     7.6398     7.3934     7.6398     7.3934     7.6398     7.6398     7.3934     7.6398     7.3934     7.6398 (231)
Lighting         60.1685    48.2694    43.4613    31.8416    24.5954    20.0946    22.4367    29.1641    37.8813    49.7023    56.1386    61.8408 (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                                                                                          2528.5138 (211)
Space heating fuel - main system 2                                                                                             0.0000 (213)
Space heating fuel - secondary                                                                                                 0.0000 (215)
Efficiency of water heater                                                                                                   169.5696
Water heating fuel used                                                                                                     1022.6477 (219)
Space cooling fuel                                                                                                             0.0000 (221)

Electricity for pumps and fans:
    (MEVDecentralised, Database: total watage = 4.9565, total flow = 45.0000, SFP = 0.1101)
  mechanical ventilation fans (SFP =        0.1101)                                                                          89.9525 (230a)
Total electricity for the above, kWh/year                                                                                    89.9525 (231)
Electricity for lighting (calculated in Appendix L)                                                                         485.5945 (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	4819.2767	(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	2528.5138	0.1558	393.8743	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1022.6477	0.1407	143.8879	(264)
Energy for instantaneous electric shower(s)	692.5682	0.1391	96.3516	(264a)
Space and water heating			537.7622	(265)
Pumps, fans and electric keep-hot	89.9525	0.1387	12.4775	(267)
Energy for lighting	485.5945	0.1443	70.0863	(268)
Total CO2, kg/year			716.6776	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.6800	(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	2528.5138	1.5767	3986.6286	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1022.6477	1.5203	1554.6822	(278)
Energy for instantaneous electric shower(s)	692.5682	1.5143	1048.7796	(278a)
Space and water heating			5541.3108	(279)
Pumps, fans and electric keep-hot	89.9525	1.5128	136.0802	(281)
Energy for lighting	485.5945	1.5338	744.8211	(282)
Total Primary energy kWh/year			7470.9917	(286)
Dwelling Primary energy Rate (DPER)			27.9100	(287)

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

1. Overall dwelling characteristics

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	132.8000	(1b)	x	2.4000	(2b)	=	318.7200	(1b) - (3b)
First floor	134.8800	(1c)	x	2.6000	(2c)	=	350.6880	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 267.6800								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	669.4080	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0598	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3098	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2633	(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	0.3357	0.3291	0.3225	0.2896	0.2830	0.2501	0.2501	0.2435	0.2633	0.2830	0.2962	0.3094	(22b)
Effective ac	0.5563	0.5542	0.5520	0.5419	0.5401	0.5313	0.5313	0.5297	0.5347	0.5401	0.5439	0.5479	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9100	1.0000	1.9100			(26)

TER Semi-glazed door			1.9100	1.0000	1.9100	(26a)
TER Opening Type (Uw = 1.20)			44.9900	1.1450	51.5153	(27)
Heatloss Floor 1			132.8000	0.1300	17.2640	(28a)
Heatloss Floor 2			37.4600	0.1300	4.8698	(28b)
External Wall 1	278.9740	48.8100	230.1640	0.1800	41.4295	(29a)
External Roof 1	134.8800		134.8800	0.1100	14.8368	(30)
Total net area of external elements Aum(A, m2)			584.1140			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	133.7354	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 106.0152 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	27.7300	0.0500	1.3865
E3 Sill	25.9100	0.0500	1.2955
E4 Jamb	46.9000	0.0500	2.3450
E5 Ground floor (normal)	52.1600	0.1600	8.3456
E6 Intermediate floor within a dwelling	59.1500	0.0000	0.0000
E16 Corner (normal)	20.0000	0.0900	1.8000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.1726 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 148.9080 (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	122.8994	122.4161	121.9423	119.7170	119.3007	117.3626	117.3626	117.0037	118.1091	119.3007	120.1430	121.0235	(38)
Heat transfer coeff	271.8074	271.3241	270.8503	268.6250	268.2087	266.2706	266.2706	265.9117	267.0171	268.2087	269.0509	269.9315	(39)
Average = Sum(39)m / 12 =												268.6230	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0154	1.0136	1.0118	1.0035	1.0020	0.9947	0.9947	0.9934	0.9975	1.0020	1.0051	1.0084	(40)
HLP (average)												1.0035	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0899 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	76.0276	74.8850	73.2201	70.0346	67.6838	65.0622	63.5720	65.2243	67.0356	69.8504	73.1044	75.7363	(42a)
Hot water usage for baths	32.8176	32.3302	31.6438	30.3783	29.4308	28.3800	27.8125	28.4940	29.2361	30.3604	31.6520	32.7066	(42b)
Hot water usage for other uses	46.2738	44.5911	42.9084	41.2258	39.5431	37.8604	37.8604	39.5431	41.2258	42.9084	44.5911	46.2738	(42c)
Average daily hot water use (litres/day)												142.5890	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	155.1190	151.8063	147.7724	141.6387	136.6576	131.3026	129.2449	133.2614	137.4974	143.1193	149.3474	154.7167	(44)
Energy conte	245.6705	216.1702	227.1207	193.8963	183.9674	161.4518	156.3105	165.0055	169.5481	194.2115	212.7728	242.2490	(45)
Energy content (annual)										Total = Sum(45)m =		2368.3745	
Distribution loss (46)m = 0.15 x (45)m	36.8506	32.4255	34.0681	29.0844	27.5951	24.2178	23.4466	24.7508	25.4322	29.1317	31.9159	36.3374	(46)

Water storage loss:

Store volume 200.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6525 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.8924 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(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	296.5966	262.1680	278.0468	243.1796	234.8935	210.7351	207.2366	215.9316	218.8314	245.1376	262.0561	293.1751	(62)
WWHRS	-34.7566	-30.7391	-32.1882	-26.6531	-24.8397	-21.2555	-19.9237	-21.1868	-21.9918	-25.9259	-29.3709	-34.1130	(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	261.8400	231.4289	245.8586	216.5265	210.0538	189.4796	187.3129	194.7448	196.8396	219.2117	232.6852	259.0621	(64)
								Total per year (kWh/year) = Sum(64)m =				2645.0438	(64)
12Total per year (kWh/year)												2645	(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	122.4263	108.6748	116.2585	103.8972	101.9100	93.1094	92.7141	95.6052	95.8014	105.3162	110.1736	121.2887	(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	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	154.4957	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	224.9535	249.0556	224.9535	232.4519	224.9535	232.4519	224.9535	224.9535	232.4519	224.9535	232.4519	224.9535	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	431.5333	436.0113	424.7270	400.7040	370.3792	341.8783	322.8379	318.3599	329.6443	353.6673	383.9920	412.4929	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	38.4496	(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)	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	-123.5966	(71)
Water heating gains (Table 5)	164.5515	161.7184	156.2614	144.3016	136.9758	129.3186	124.6157	128.5016	133.0575	141.5540	153.0189	163.0224	(72)
Total internal gains	893.3870	919.1341	878.2905	849.8062	804.6572	772.9975	741.7558	741.1637	764.5023	792.5234	841.8115	872.8175	(73)

---

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W	
North	5.6500	10.6334	0.6300	0.7000	0.7700	18.3608	(74)
East	0.5800	19.6403	0.6300	0.7000	0.7700	3.4813	(76)
South	32.6700	46.7521	0.6300	0.7000	0.7700	466.7902	(78)
West	6.0900	19.6403	0.6300	0.7000	0.7700	36.5541	(80)

Solar gains	525.1865	877.8885	1162.4169	1384.5004	1506.4613	1477.8536	1432.0498	1342.5989	1238.9588	959.2647	625.8756	451.5794	(83)
Total gains	1418.5735	1797.0225	2040.7074	2234.3066	2311.1185	2250.8511	2173.8056	2083.7625	2003.4611	1751.7881	1467.6870	1324.3969	(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	29.0015	29.0532	29.1040	29.3451	29.3906	29.6045	29.6045	29.6445	29.5218	29.3906	29.2986	29.2030	
alpha	2.9334	2.9369	2.9403	2.9563	2.9594	2.9736	2.9736	2.9763	2.9681	2.9594	2.9532	2.9469	
util living area	0.9771	0.9553	0.9242	0.8665	0.7752	0.6369	0.4957	0.5306	0.7158	0.8884	0.9607	0.9810	(86)
MIT	18.5726	18.9573	19.4265	19.9839	20.4564	20.7902	20.9271	20.9087	20.6837	20.0462	19.1999	18.5029	(87)
Th 2	20.0705	20.0720	20.0735	20.0804	20.0817	20.0877	20.0877	20.0888	20.0854	20.0817	20.0791	20.0763	(88)
util rest of house	0.9736	0.9486	0.9126	0.8452	0.7370	0.5724	0.4070	0.4429	0.6584	0.8661	0.9537	0.9781	(89)
MIT 2	17.2003	17.6880	18.2792	18.9743	19.5410	19.9157	20.0440	20.0311	19.8079	19.0636	18.0046	17.1152	(90)
Living area fraction									fLA = Living area / (4) =			0.1381	(91)
MIT	17.3898	17.8632	18.4376	19.1137	19.6674	20.0364	20.1660	20.1523	19.9288	19.1993	18.1697	17.3068	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3898	17.8632	18.4376	19.1137	19.6674	20.0364	20.1660	20.1523	19.9288	19.1993	18.1697	17.3068	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9584	0.9267	0.8861	0.8181	0.7174	0.5684	0.4150	0.4494	0.6474	0.8394	0.9332	0.9647	(94)
Useful gains	1359.5096	1665.3707	1808.2726	1827.9590	1658.1027	1279.4396	902.1998	936.3906	1297.0196	1470.4562	1369.6258	1277.6330	(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	3557.8925	3517.2370	3233.3000	2743.6599	2136.9269	1447.5573	949.5095	997.7682	1556.3936	2306.3942	2978.3048	3537.9387	(97)
Space heating kWh	1635.5969	1244.4542	1060.2204	659.3047	356.2452	0.0000	0.0000	0.0000	0.0000	621.9379	1158.2489	1681.6675	(98a)
Space heating requirement - total per year (kWh/year)												8417.6756	
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	1635.5969	1244.4542	1060.2204	659.3047	356.2452	0.0000	0.0000	0.0000	0.0000	621.9379	1158.2489	1681.6675	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8417.6756	
Space heating per m2											(98c) / (4) =	31.4468	(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	1635.5969	1244.4542	1060.2204	659.3047	356.2452	0.0000	0.0000	0.0000	0.0000	621.9379	1158.2489	1681.6675	(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)	1772.0444	1348.2710	1148.6678	714.3063	385.9644	0.0000	0.0000	0.0000	0.0000	673.8222	1254.8742	1821.9583	(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	261.8400	231.4289	245.8586	216.5265	210.0538	189.4796	187.3129	194.7448	196.8396	219.2117	232.6852	259.0621	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4391	87.2569	86.9539	86.3912	85.2343	79.8000	79.8000	79.8000	79.8000	86.2645	87.1556	87.4830	(217)
Fuel for water heating, kWh/month	299.4540	265.2272	282.7458	250.6349	246.4426	237.4431	234.7280	244.0411	246.6662	254.1157	266.9767	296.1287	(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	46.7409	37.4973	33.7621	24.7356	19.1065	15.6102	17.4296	22.6556	29.4274	38.6103	43.6103	48.0400	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-106.4457	-141.8239	-192.6558	-204.1237	-209.8404	-191.9427	-189.1595	-183.1923	-171.7652	-155.5555	-113.8639	-92.9879	(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	-87.9997	-181.0189	-352.6728	-519.9059	-678.5045	-678.8710	-671.2369	-572.6762	-425.3813	-255.9487	-116.4586	-69.9417	(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 9119.9086 (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	3124.6040	(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)	377.2257	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-6563.9727	(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	6143.7655	(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	9119.9086	0.2100	1915.1808	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3124.6040	0.2100	656.1668	(264)
Space and water heating			2571.3476	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	377.2257	0.1443	54.4453	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1953.3564	0.1359	-265.4162	
PV Unit electricity exported	-4610.6163	0.1264	-582.9779	
Total			-848.3940	(269)
Total CO2, kg/year			1789.3282	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			6.6800	(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	9119.9086	1.1300	10305.4967	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3124.6040	1.1300	3530.8025	(278)
Space and water heating			13836.2992	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	377.2257	1.5338	578.6014	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1953.3564	1.5022	-2934.4284	
PV Unit electricity exported	-4610.6163	0.4642	-2140.0369	
Total			-5074.4654	(283)
Total Primary energy kWh/year			9470.5360	(286)
Target Primary Energy Rate (TPER)			35.3800	(287)

APPENDIX B

Predicted Energy Assessment

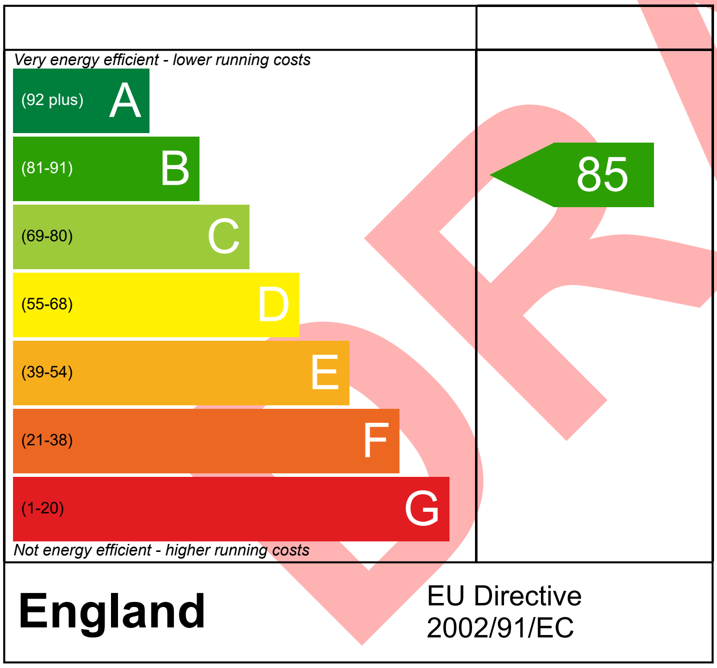
Stanmore House, House Type B, Ewen, Cotswold, Gloucestershire, GL7 6BU

Dwelling type:	House, Detached
Date of assessment:	24/01/2024
Produced by:	Georgina O'Connor
Total floor area:	254.38 m²
DRRN:	

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

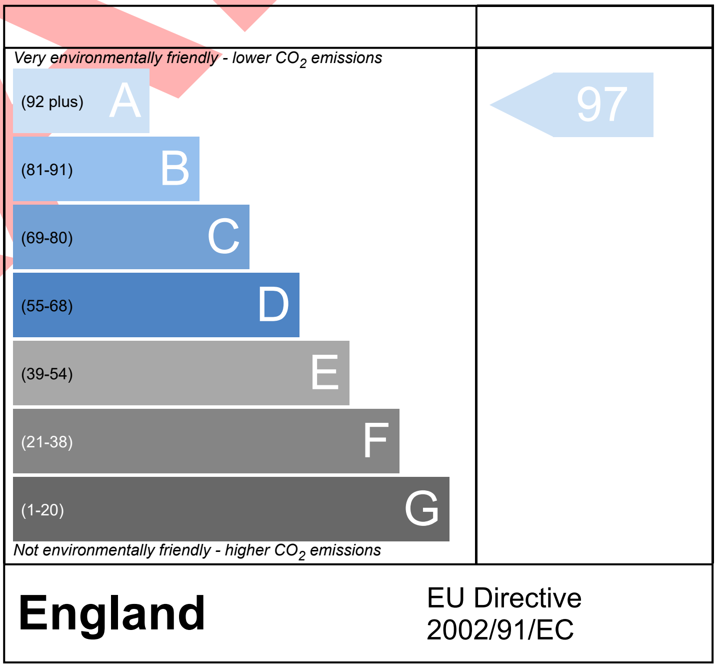
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment

elmhurst energy

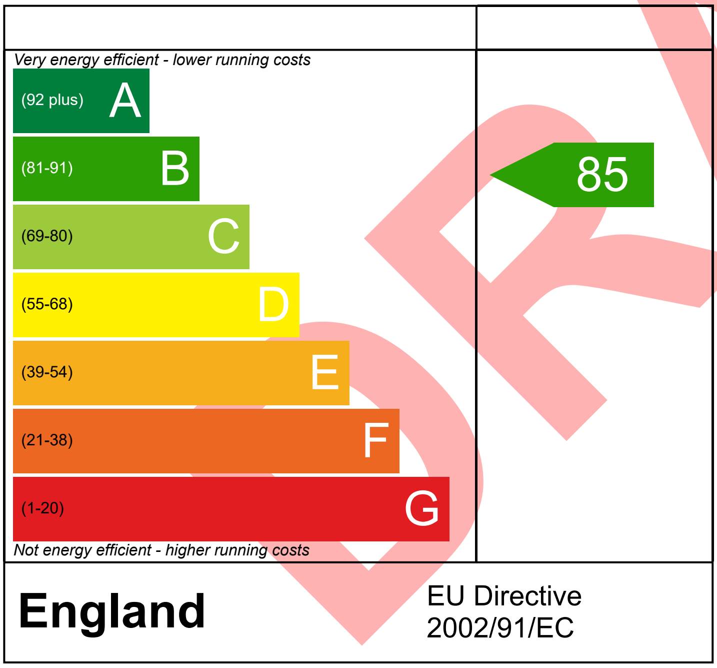
Stanmore House, House Type C, Ewen, Cotswold, Gloucestershire, GL7 6BU

Dwelling type:	House, Detached
Date of assessment:	24/01/2024
Produced by:	Georgina O'Connor
Total floor area:	259.02 m²
DRRN:	

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

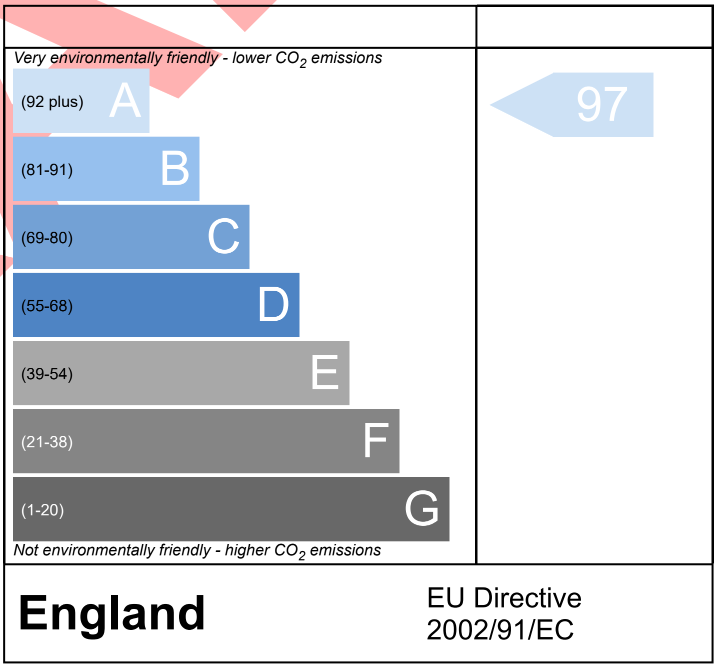
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

Predicted Energy Assessment

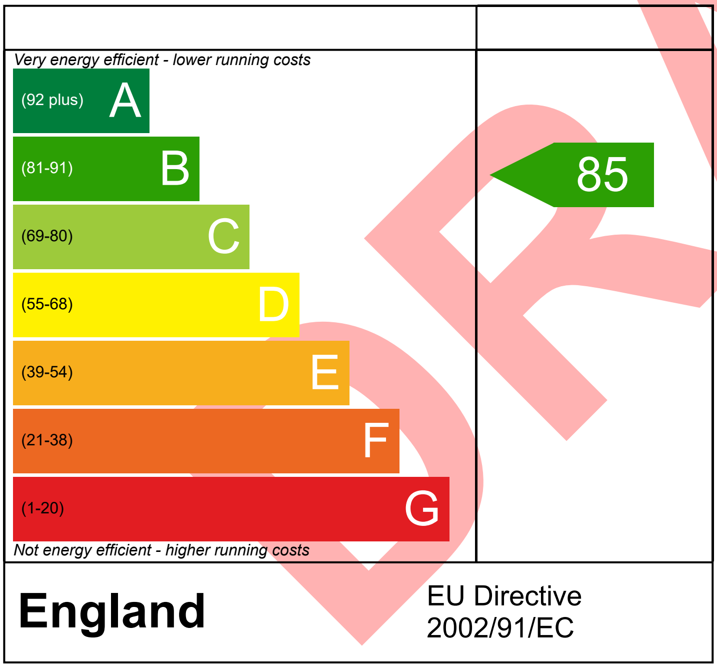
Stanmore House, House Type D, Ewen, Cotswold, Gloucestershire, GL7 6BU

Dwelling type:	House, Detached
Date of assessment:	24/01/2024
Produced by:	Georgina O'Connor
Total floor area:	267.68 m²
DRRN:	

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

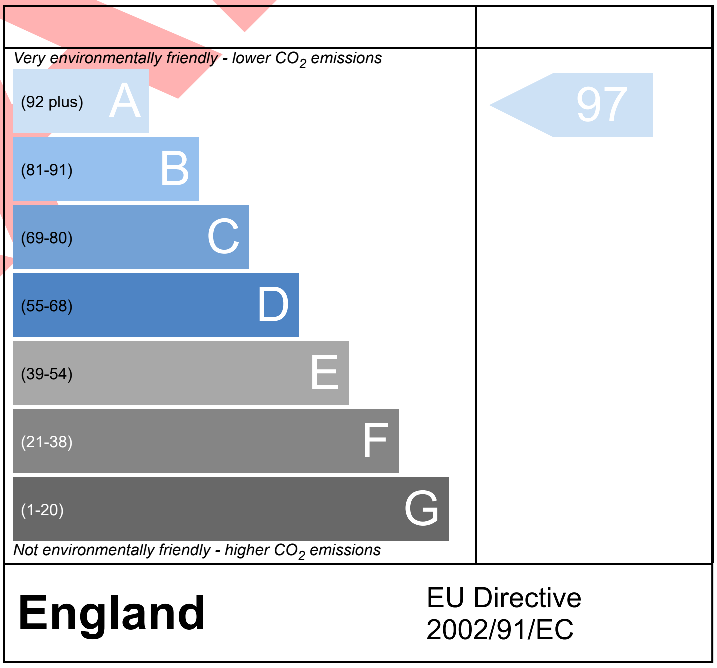
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

APPENDIX C

Resi Resolve
Lytchett House, 13 Freeland Park
Wareham Road, Poole
Dorset, BH16 6FA
Tel: 07748 778047
Email: georgie@resi-resolve.co.uk

RESI RESOLVE
sustainability

SAP SUMMARY SPECIFICATION (PRELIMINARY)		
	Site	Stanmore House
	Site Reference	MOR/0001/23
	OCDEA	Georgie O'Connor
	Building Regulations	SAP 10 / Part L 2021

Constructions and Thermal Properties of Building Fabric		
Element	**Description**	**u-value (W/m²k)**
External Wall	125mm stone outer leaf, 125mm cavity fully filled mineral slab, 100mm aircrete block inner leaf	0.18
Main Roof	400mm mineral wool insulation (0.044 Lambda)	0.11
Sloping Ceiling	100mm PIR type insulation between rafters, 52.5mm PIR insulation below rafters	0.18
Ground Floor	75mm cement: sand screed on 150mm PIR on Beam & Block floor	0.11-0.12 (p/a ratio)
Windows	Double glazed with argon fill, BFRC Approved, 'g' factor 0.44	1.30
Main Door	Insulated door	1.10

Resi Resolve
Lytchett House, 13 Freeland Park
Wareham Road, Poole
Dorset, BH16 6FA
Tel: 07748 778047
Email: georgie@resi-resolve.co.uk

Thermal Bridging
Recognised Construction Details (www.recognisedconstructiondetails.co.uk)

Ventilation
DMEV - Greenwood Unity CV3 (or similar)

Air Tightness
4.5

Lighting
Power 5W / Efficacy 80 lm/W / Capacity 400 lm

Heating, Community Heating and Secondary Heating	
Heating System	**Make & Model**
Main Heating 1	Vaillant aroTHERM 8kW (or similar)
Flow Temperature	35
Main Heating 2	No
Other/ Community Heating	No
Secondary Heating	No
Heat Emitter	Radiators & Underfloor
Heating Controls	Time and temperature zone control
Boiler Interlock	N/A
Delayed Start Stat	N/A
Compensator	N/A

Water Heating	
System	**Details**
From Main Heating	Yes
Heat Recovery System	No
Cylinder	Assumed 200 litre cylinder 1.4 loss - Heating designs to confirm

Additional Renewable Technologies
ASHP as main heating system

Applicable Planning Conditions / Guidance
Local Plan Policy EN1 & EN2 / Cotswold Design Code / Net Zero Carbon Toolkit

Client Declaration
Not applicable at this stage

APPENDIX D

Residential

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for residential buildings

	Carbon Dioxide Emissions for residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	5.5	
After energy demand reduction (be lean)	5.3	
After heat network connection (be clean)	4.5	
After renewable energy (be green)	2.2	

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for residential buildings

	Regulated residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.2	4%
Be clean: savings from heat network	0.8	14%
Be green: savings from renewable energy	2.3	42%
Cumulative on site savings	**3.3**	**60%**
Annual savings from off-set payment	2.2	-

SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	5.5		
Be lean	5.3	0.2	4%
Be clean	4.5	0.8	14%
Be green	2.2	2.3	42%
Total Savings	-	3.3	60%

Prepared by
RESI RESOLVE

Lytchett House, 13 Freeland Park
Wareham Road, Poole
Dorset, BH16 6FA

Tel: 07748 778047
Email: georgie@resi-resolve.co.uk