



# **WEST BRADLEY HOUSE** **Glastonbury, BA6 8LT**

## **Energy Statement**

**Revision 01**

**26<sup>th</sup> February 2024**

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## EXECUTIVE SUMMARY

The West Bradley House site consists of multiple buildings within the same site. The Main House and Apple Barn make up the majority of the proposed works to the existing and listed elements of the site. These buildings are to be refitted and upgraded as detailed internally but will have minimal physical alterations to their external facades. The Leisure Barn and Cart Shed are to be new build elements replacing existing structures. The new build elements of the development therefore do not make up over 1000m<sup>2</sup> of floor space and should be considered a minor development. However, given the total scale of the site, this Energy Statement has been prepared to cover both elements.

Throughout this report, both the new and refurbished buildings are assessed and the energy savings reported. However given the different design conditions for each these savings should be kept separate and individually reviewed.

This report describes how the proposed development responds to an objective of reduced energy consumption and CO<sub>2</sub> emissions.

The approach seeks to go beyond minimal requirements of Building Regulations and takes account of current guidance in this area, particularly Mendip Council's Strategies and Policies (LPP1) Policy DP7.

The energy strategy encourages new developments to conserve energy using a defined energy hierarchy, which should be implemented in the following order:-

- Use less energy.
- Supply energy efficiently
- Use renewable energy.

Our analysis has consisted of :-

- Calculating the energy demand and CO<sub>2</sub> emissions reductions that can be reached in the development by employing energy reduction techniques using software modelling.
- Investigating the viability of renewable energy technologies and their contribution to achieving CO<sub>2</sub> emission reductions

In summary, this report confirms that, for the combined development: -

- The proposed new build construction is responsible for 8% reduction in CO<sub>2</sub> emissions over the minimum requirement for the building due to passive design features, such as the provision of high levels of thermal insulation, airtightness and low energy lighting.
- A further 49.4% carbon reduction is then achieved with Air & Ground source heat pump heating.
- The above total represents a total carbon reduction of 57.4% for Part L1 2021 on the new build units.
- The existing renovated buildings achieve an 83.8% reduction over there existing conditions due to improvements in thermal insulation, low energy lighting and replacing the existing heating system with heat pumps.

- All energy and carbon figures have been calculated using approved Standardised Assessment Procedure SAP 10, which is used to demonstrate compliance with Approved Document Part L1 2021 edition.

Table 1: Carbon dioxide reduction summary (New Buildings):

	Carbon dioxide emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulation Compliant Development	5.59	1.94
After energy demand reduction	5.15	1.94
After Heat network/CHP	n/a	1.94
After Renewables (Heat Pump)	2.39	1.94

Table 2: Carbon dioxide savings (New Buildings):

	Regulated Domestic Carbon dioxide Savings	
	Tonnes CO2 per annum	Percentage
Savings from energy demand reduction	0.45	8%
Savings from heat network/CHP	n/a	n/a
Saving from renewable energy	2.77	49.4%
Total Cumulative Savings	3.21	57.4%

Figure 1: The Domestic Energy Hierarchy (New Buildings):

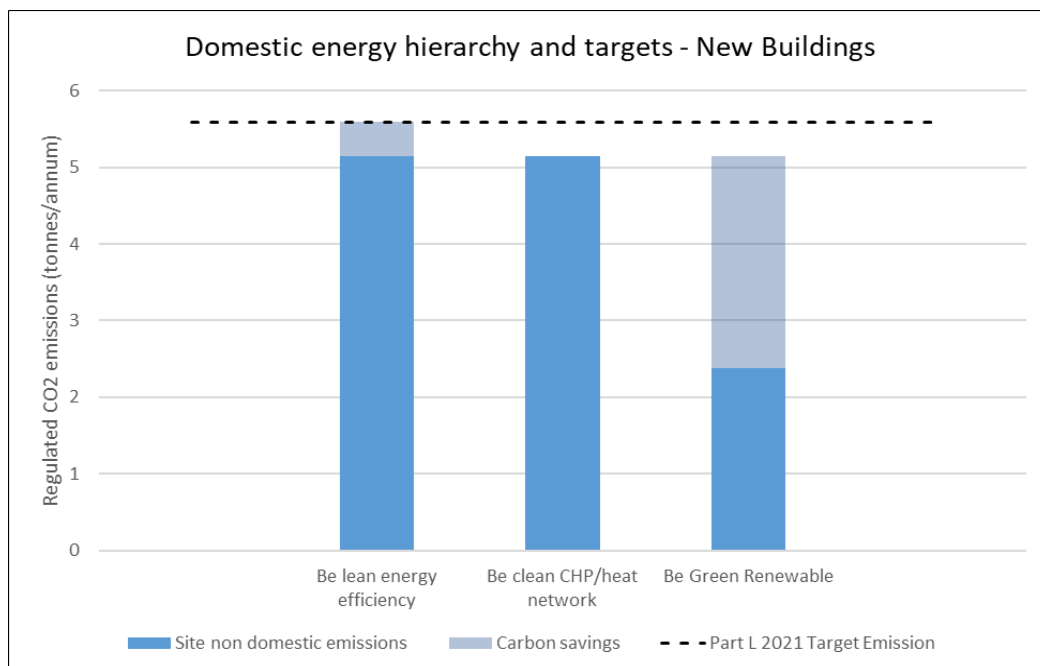
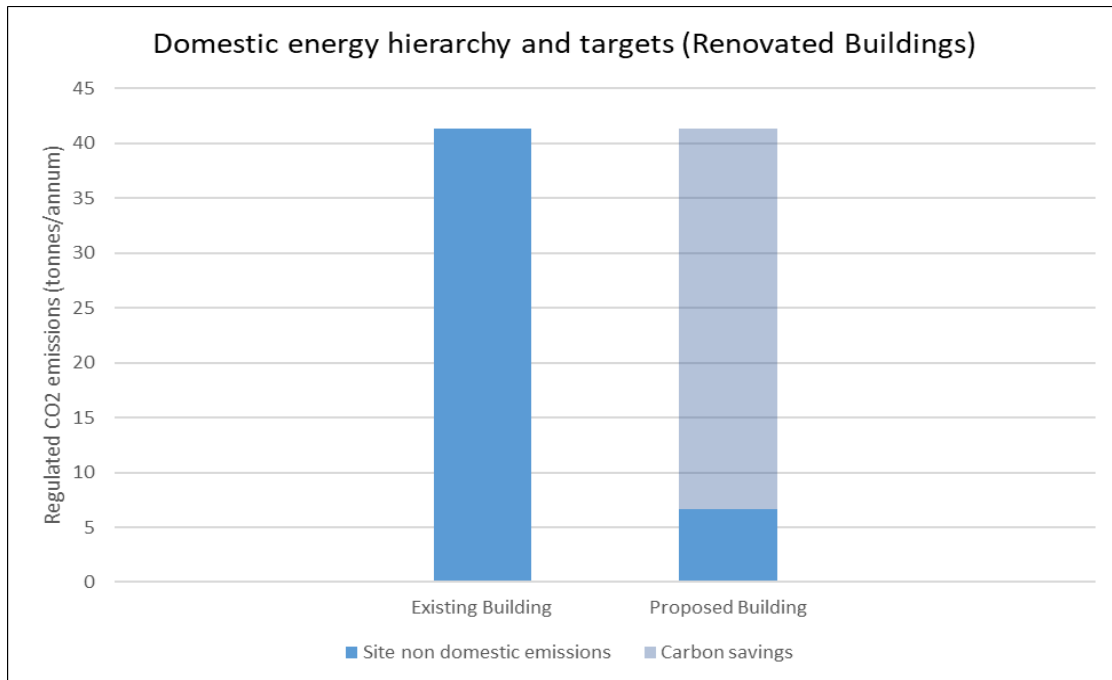


Table 3: Carbon dioxide reduction summary (Existing Buildings):

	Carbon dioxide emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Existing Building	<b>41.37</b>	1.42
Renovated/ upgraded building	<b>6.69</b>	1.42

Figure 2: The Domestic Energy Hierarchy (Renovated Buildings):



## INTRODUCTION

### Scope

This report has been prepared in line with the Mendip council planning policy DP7, it describes how the proposed development achieves savings in energy and carbon dioxide emissions (CO<sub>2</sub>) following a deliberately ordered strategy of measures to reduce energy consumption and using necessary energy more efficiently.

### Policy

Local plan policy DP7 requires all the major developments to submit an Energy Statement demonstrating that the development incorporates all practical measure to achieve energy efficiency exceed than Building Regulations Part L (2021) requirements having regard to feasibility and viability. This may be achieved through a combination of energy efficiency measures, incorporation of on-site low carbon and renewable technologies, connection to a local, decentralised, renewable of low carbon energy supply.

The structure of this report follows the ordered approach of the hierarchy, discussing compliance with Building Regulations and using less energy, supplying energy efficiently, and finally deploying an effective renewable energy solution to the building once the first two stages have been completed. Following is the hierarchy.

- 1- Use less energy, Use less energy, by adopting sustainable design and construction measures.
- 2- Supply energy efficiently, Supply energy efficiently, by prioritising decentralised energy generation.
- 3- Use renewable energy

This hierarchy has been used in parallel with the requirements of current Building Regulations for the conservation of fuel and power (Part L1: 2021), which sets out a specific benchmark of performance for the basic building design.

### Building characteristics

The proposed development is a Grade 2 listed house with outbuildings. The listed part of the house is being retained with other parts (Apple Barn) being completely renovated. To the north of the main house are array of outbuildings which are being demolished and rebuilt, these are as follows:

- Red Brick Barn – Existing building renovated with thermal elements upgraded.
- The Cart Shed - Existing building demolished and replaced with new building.
- The Leisure Shed and Pool – Existing building demolished and replaced with new building.

The House, the existing main part and proposed largely converted Apple Barn are considered together as one, with all the outbuildings considered as separate buildings.

The Main house (with Apple Barn) is a 5 storied dwelling with approximate area 1020m<sup>2</sup>, this will be the main dwelling space, with living areas, bedrooms, and kitchen.

The Cart Shed, is a standalone single storied unit with guest accommodation which consists of 5 ensuite bedrooms.

The Leisure Shed and Pool, is a single storied unit with swimming pool, Gym and bar.

Redbrick barn is a standalone single storied unit which will be used as a studio/office with kitchenette.

## Part L 2021

The energy performance of the building is calculated using the approved SAP software (Elmhurst energy). This software models the carbon dioxide emission rates produced by a building in accordance with Part L1A of the Building Regulations (2021). The software is approved for use by the Department for Communities and Local Government (DGLG).

The building will be assessed under Part L1 2021 (SAP 10.2) and as such, it is a requirement that the building meet the minimum building regulations in terms of the maximum façade U-Values, minimum values for energy efficiencies and minimum values for CO<sub>2</sub> reductions; figure 3 below details the minimum Part L1A requirements for the building construction elements used by a notional building (**Source: SAP 2012**).

The new units have been assessed as new dwellings with SAP10, however, refurbished / extended units will be assessed as renovation / extension to existing dwellings.

Fuel CO<sub>2</sub> emission factors based on the SAP document for Part L1A 2021 compliance have been applied to the model in order to calculate the CO<sub>2</sub> emissions that will be produced as a result of the running of the systems outlined within table 4 below;

Table 4: Fuel Carbon Emission Factor

System	Fuel Source	Emission Factor (KgCO <sub>2</sub> /kWh)
Heating	Natural Gas	0.21
Cooling Energy	Grid Electricity	0.136
Lighting Energy	Grid Electricity	0.136
Pump / Fan Energy	Grid Electricity	0.136
DHW Energy	Natural Gas	0.21

Table 4.1 Limiting U-values for new fabric elements and air permeability in new dwellings	
Element type	Maximum U-value <sup>(1)</sup> W/(m <sup>2</sup> ·K)
All roof types <sup>(2)</sup>	0.16
Wall <sup>(3)</sup>	0.26
Floor	0.18
Party wall	0.20
Swimming pool basin <sup>(3)</sup>	0.25
Window <sup>(4)(5)</sup>	1.6
Rooflight <sup>(6)(7)</sup>	2.2
Doors (including glazed doors)	1.6
Air permeability	8.0m <sup>3</sup> /(h·m <sup>2</sup> ) @ 50Pa 1.57m <sup>3</sup> /(h·m <sup>2</sup> ) @ 4Pa

**NOTES:**

1. Area-weighted average values.
2. For dormer windows, 'roof' includes the roof parts of the windows and 'wall' includes the wall parts (cheeks).
3. The U-value of a swimming pool basin (walls and floor) calculated according to **BS EN ISO 13370**.
4. If performance requires thicker glass to be used, an equivalent window unit with standard thickness (6mm) glazing should be shown to meet the required standard.
5. Including roof windows and curtain walling.
6. U-values for rooflights or rooflight-and-kerb assemblies should be based on the developed surface area of the rooflight (U<sub>a</sub>-values), which is often greater than the area of the roof opening. Further guidance on U<sub>a</sub>-values is given in the Building Research Establishment's BR 443 and the National Association of Rooflight Manufacturers' Technical Document NTD02.
7. The limiting value for rooflights also applies to kerbs that are supplied as part of a single rooflight-and-kerb assembly sourced from the same supplier and for which the supplier can provide a combined U<sub>a</sub>-value for the assembly. An upstand built on site should not exceed a U-value of 0.35W/(m<sup>2</sup>·K).

Figure 3: Part L1A Maximum Construction U-values.

## Target Building Model (TER)

The target building represents the 'baseline' building for the proposed development which just meets the minimum standards of CO<sub>2</sub> emissions reduction (i.e. the Dwelling Emissions Rate (DER) is equal to the Target Emissions Rate (TER), as defined by Part L of the Building Regulations 2021.

Allowances for energy consumption not included under Part L have been made by reference to published material or by calculations as detailed in BREDEM 12. These include small power (energy use for electrical appliances) and cooking. The energy breakdown and carbon dioxide emissions by end user as part of the study for a dwelling, SAP 10 calculation methodology was developed and analysed using the Elmhurst energy Software (Version 1.9.7ERC v1.7.7).

Unregulated energy use and the associated carbon dioxide emissions for the buildings has been calculated using the SAP document as recognised in BREDEM 12, as well as evidence established through previous development work.

The energy and carbon emission below represent the whole development.

Table below outlines the target building 2021 Emission rates for the building with electric heating:

*Table 5: Notional building CO2 emissions (for Leisure Shed & The Cart Shed) ;*

	Total Emission (kgCO <sub>2</sub> / annum)	Total Emission (kgCO <sub>2</sub> / annum/m <sup>2</sup> )
Building Regulations 2021, Part L Compliant Development	5,590	8.59

*Table 6: Existing building with notional extension CO2 emissions (for Main House & Red Brick Barn) ;*

	Total Emission (kgCO <sub>2</sub> / annum)	Total Emission (kgCO <sub>2</sub> / annum/m <sup>2</sup> )
Building Regulations 2021, Part L Compliant Development	41,370	38.2

### **Cooling and overheating**

Passive measures like optimal window openable area, and lower g-value windows have been incorporated to limit the space solar gain to ensure that the risk of summer overheating and reliance on mechanical cooling is minimised in line with the ‘cooling hierarchy’, refer to SAP reports in appendix.

The initial analysis using SAP software shows that the solar gain limits in summer have not been exceeded for any of the spaces within the dwelling and there is no significant risk of summertime overheating. The dwelling will have mechanical heat recovery ventilation for background ventilation with openable windows summertime overheating and purge ventilation.



## THE ENERGY HIERARCHY – COMPLIANCE WITH BUILDING REGULATIONS

The first stage of the hierarchy uses compliance with L1A of the 2021 Building Regulations as a benchmark for the ‘worst performing’ but legally permissible development.

According to Building Regulations Part L the approach to showing compliance is that the annual CO<sub>2</sub> emission rate of the completed building must not exceed the target set by reference to a notional building.

### ENERGY HIERARCHY STEP 1- USING LESS ENERGY

Complying with the first stage of the energy hierarchy can be achieved by implementing ‘passive’ energy efficiency measures to reduce the demand for energy.

This development will benefit from: -

- The provision of high thermal performance by means of increased insulation and double-glazed window systems to reduce heat loss.
- Air-tight construction techniques to minimise unwanted air infiltration, certified air-tight windows and post completion air-pressure testing to ensure compliance with design standards.
- Mechanical heat recovery ventilation for the Pool building and The cart shed.
- Reducing summertime overheating by providing windows with lower g-value, and external window blinds
- Openable windows with cross ventilation.
- A-rated appliances. Water saving measures such as spray taps.
- Low energy light fittings.
- Good levels of natural lighting with south facing windows

Table 5 summarises the proposed construction related measures affecting the thermal performance of the building.

*Table 7: Thermal performance for the proposed building in comparison with the base case building*

U-values (W/m <sup>2</sup> K)	Current building regulations minimum*	Values for the proposed development
Walls	0.26	0.18
Floors	0.18	0.13
Roofs	0.16	0.12
Party Walls	0.20	n/a
Windows and glazed doors	1.6	1.6
Air permeability	10m <sup>3</sup> /m <sup>2</sup> h at 50 Pa	4m <sup>3</sup> /m <sup>2</sup> h at 50 Pa

\*=Simplified area weighted averages, Part L1A

The Part L calculation summary for the domestic is given in tables below 6.

*Table 8: Part L output – Energy consumption*

	Energy Consumption kWh/year	
	Notional Building	Proposed building
Heating	33,694	9,413
Domestic hot water	6,561	2,806
Auxiliary power	172	760
Lighting	808	3,019
Displaced electricity	-24,186	0
<b>Total</b>	<b>17,048</b>	<b>15,998</b>

*Table 9: Part L output – Carbon emissions*

	CO2 Emissions kgCO2/m2		
	Notional Building	Proposed building (BR compliant)	Proposed building
Heating	10.87	2.81	2.24
Domestic hot water	2.12	0.61	0.61
Auxiliary power	0.04	0.75	0.64
Lighting	0.17	0.17	0.17
Displaced electricity	-4.61	0	0
<b>Total</b>	<b>8.59</b>	<b>4.35</b>	<b>3.66</b>

The notional building emission rate (TER) is 8.59 and the DER (Dwelling emission rate) is 3.66 kgCO2/m2.

**This represents a total of 57.4% reduction in carbon emission over the Target Emissions Rate (TER) with improved building fabric efficiency and renewable technologies Ground/Air source heat pump and photovoltaics.**

Table 10: Part L output – Energy consumption (Renovated/upgraded units)

	Energy Consumption kWh/year	
	Notional Building	Proposed building
Heating	1,88,791	39,660
Domestic hot water	7,464	3,097
Auxiliary power	82	0
Lighting	1024	959
Displaced electricity	-24,186	0
<b>Total</b>	<b>197,361</b>	<b>43,716</b>

Table 11: Part L output – Carbon emissions (Renovated/upgraded units)

	CO2 Emissions kgCO2/m2	
	Notional Building	Proposed building (BR compliant fabric)
Heating	36.61	5.65
Domestic hot water	1.45	0.4
Auxiliary power	0.01	0.01
Lighting	0.14	0.13
Displaced electricity	0	0
<b>Total</b>	<b>38.2</b>	<b>6.18</b>

The existing with notional extension (renovation) has building emission rate is 38.2 kgCO2/m2 and the Dwelling emission rate renovated and fabric is 6.18 kgCO2/m2.

**This represents a total of 83.8% reduction in carbon emission over the existing building with improved building fabric efficiency and renewable technologies Air source heat pump.**

## **ENERGY HIERARCHY STEP 2: SUPPLYING ENERGY EFFICIENTLY**

Combined heat and power (CHP) has been considered for the development.

It has been investigated and found that a CHP solution would not be the most feasible technology for the development, due to the suitability of such system on a scheme of this scale and affordability.

Further, following the Energy Planning GLA guidance, it is not expected that small purely residential developments include on-site CHP. Therefore, given the size and nature of the development and the requirement for thermal demand, a CHP solution is deemed not to be the most suitable low carbon technology for the site.

In addition to the above, a Side Wide Heat Network is not considered as a feasible option to the proposed development but there are no current energy supply plants/sites in proximity of the proposed development site area. The proposed site is not closer to existing District heating transmission line or the potential future district heating transmission line. Hence the district heating has been discounted for the scheme.

### **ENERGY HIERARCHY STEP 3: USING RENEWABLE ENERGY**

Having established the improved emission rate through the means detailed in steps 1 and 2, further savings may be made through the integration of renewable technologies.

Each of the available technologies as set out in the London plan have been considered. It was established that air source heat pump is the most suitable renewable technology for the site.

#### **Photovoltaics**

Photovoltaics (PV) panels convert solar energy into electricity. They must be in a generally southern facing orientation at ideally, 30° to the horizontal. Residential building will have a reasonable steady regulated energy demand along with potentially high unregulated electricity demand, PV's could be a suitable Zero carbon technology.

PVs cannot be installed on the main house roof due to its listed nature. This building has substantial electrical load compared to the outbuildings. The outbuildings are used occasionally as such does not have steady regulated load to make PV system technically and financially feasible.

Hence, this technology has been excluded.

#### **Solar Hot Water**

Solar thermal panels use free heat from the sun to warm the domestic hot water. They must be located in a generally south facing position, ideally at about 30° to the horizontal.

High efficiency (evacuated tube) solar hot water panels can be accommodated on the roof of the building. Such systems are relatively low maintenance, are a proven technology and are a visible indication of the development's green aspirations.

The technology is not pursued at this stage due to cost and spatial constraints.

#### **Biomass**

We have excluded Biomass from this study, as the system emits high particulate matter (PM) and nitrogen oxide (NOx) emissions and the potential nitrous oxide (N<sub>2</sub>O) biomass and biofuel installations may not meet the air quality requirements.

Note: We have excluded CHP or CCHP running on biofuel from this study, due to the high particulate matter (PM) and nitrogen oxide (NOx) emissions and the potential nitrous oxide (N<sub>2</sub>O) biomass and biofuel installations may not meet the air quality requirements.

#### **Air/Ground source heating**

Ground source heating extracts heat from the ground, the carbon benefit being that considerably more heat energy is extracted than electrical energy is used to run the system. Whilst the generation of 1kW of electricity produces 2.6 times more CO<sub>2</sub> than the burning of 1kW of gas, ground source systems can expect to produce at least 3 times more heat energy than the electrical energy put into them (known as the Coefficient of Performance or COP) and therefore produce less CO<sub>2</sub> than the equivalent gas boiler. The system requires a connection to the general mass of the ground, either using an array of horizontal pipes buried in an open area (for example a field) or an array of vertical pipes contained within deep (perhaps 100m)

boreholes. It is sometimes possible to utilise the ground piles of a building as vertical boreholes. A horizontal system requires a substantial area of land to collect heat, about 90m<sup>2</sup> / kW. The bores for a vertical system should be placed at least 5M apart, and a 100M borehole produce about 3kW.

Air source heating operates on a similar principle to GSHP but use external ambient air as a heat source or heat sink. A high COP are required to gain worthwhile benefits over gas heating methods of heating.

High COP can be achieved when low temperature systems such as underfloor heating is utilised. Unlike gas and oil-based systems, air source heat pumps do not require regular maintenance or annual safety inspections. Additionally, a heat pump has a reasonable life expectancy of 20–25 years, typically twice that of a boiler. The pay back period is reducing as the gas costs are rising significantly comparatively, as such investment costs can be recovered much quicker than previously.

Since the grid is being continually de-carbonised, electricity is now seen as the energy source which will enable the UK and the world to achieve a zero-carbon future. This means using grid electricity becomes a lower carbon source of energy than gas. This favours electrically powered heat pumps for heating.

This renewable technology has been deemed suitable for the development. Considering the financial viability and building loads, it is proposed the buildings will be heated with an air source heat pump except the leisure shed, which will be heated with ground source heat pump. This aligns with the Net Zero Carbon pathway. The carbon emission factors (SAP10) for grid electricity can be applied to the energy consumption for the buildings to demonstrate a further reduction against the Base Building Target emissions.

## Wind Turbines

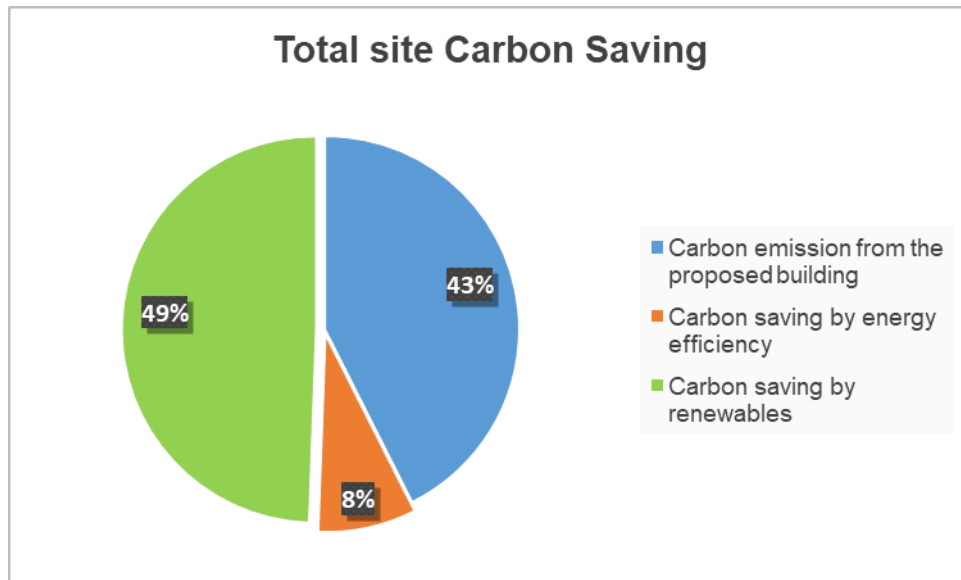
Wind turbines produce electricity directly from the energy in wind. This is then fed into the buildings electrical system via a control gear. Two types of wind turbine are available: horizontal axis and vertical axis. The former tends to be noisy and produce vibration. The latter are quieter in operation and more suited to installation on buildings but are generally less efficient and more expensive.

Wind turbines can be quite large and impact the visual appeal of landscapes, and the blades may cause unacceptable noise levels. Given such impacts, it is considered that wind turbines would not be appropriate at this location.

### Conclusion to consideration Low & Zero Carbon Technologies

After considering the different LZC technologies, it was established the air source heat pump and Ground source heat pumps are economically and technically feasible renewable technologies for the development.

*Figure 3 – Total site carbon savings*



## CONCLUSION

An energy hierarchy has been simulated to show the steps in building design improvement and their effects on the overall building performance.

Below are salient points of the core improvement over Part L1A standards applied to the Actual Building or the proposed building:

- The values for the thermal performance of the building elements are to be better than the minimum requirements of Part L1A as discussed in section 5 of this report.
- The dwellings to utilise 100% low energy lighting.
- Water saving measures such as spray taps and dual flush toilets are to be used to reduce the dwelling's water consumption.
- Mechanical heat recovery ventilation is to be used in the new buildings with high levels of air tightness.
- Low temperature hot water heating will be used throughout to achieve higher efficiencies from the Air source heat pump heating systems.
- The values for the efficiencies of the mechanical plant serving the building should be equal or better than the notional standard values.
- Air/Ground source heat pumps are deemed as the most suitable LZC technologies, For the new buildings within the dwelling all comply with Part L 2021, the carbon emission from these dwellings has been calculated to be 57.4% lower than the Part L 2021 target emission rate.
- Air source heat pumps are deemed as the most suitable LZC technologies for the existing buildings, heat pumps along with fabric improvements achieve an 84% improvement over the existing buildings.





**APPENDIX 1 – SAP 2021 REPORT.**

# Full SAP Calculation Printout



Property Reference	2324 Leisure Barn		Issued on Date	22/01/2024	
Assessment Reference	Leisure Barn-GSHP	Prop Type Ref			
Property					
SAP Rating	81 B	DER	3.15	TER	5.29
Environmental	96 A	% DER < TER	40.45		
CO <sub>2</sub> Emissions (t/year)	1.36	DFEE	45.03	TFEE	48.68
Compliance Check	See BREL	% DFEE < TFEE	7.48		
% DPER < TPER	0.69	DPER	33.02	TPER	33.25
Assessor Details	Mr. Abdul Mohammed			Assessor ID	K333-0001
Client					

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

### 1. Overall dwelling characteristics

Ground floor		Area (m <sup>2</sup> )	469.1000 (1b)	x	Storey height (m)	3.1400 (2b)	=	Volume (m <sup>3</sup> )	1472.9740 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	469.1000								(4)
Dwelling volume									(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1472.9740 (5)

### 2. Ventilation rate

									m <sup>3</sup> 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)

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									0 (19)

Shelter factor								(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor								(21) = (18) x (20) =	0.2000 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	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)
Adj infilt rate	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)
Balanced mechanical ventilation with heat recovery	0.2550	0.2500	0.2450	0.2200	0.2150	0.1900	0.1900	0.1850	0.2000	0.2150	0.2250	0.2350	(22b)
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													72.0000 (23c)
Effective ac	0.3950	0.3900	0.3850	0.3600	0.3550	0.3300	0.3300	0.3250	0.3400	0.3550	0.3650	0.3750	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K	
Window-New (Uw = 1.20)			87.3900	1.1450	100.0649			(27)
Door			4.1000	1.5000	6.1500			(26)
Heatloss Floor 1			339.3000	0.1200	40.7160	110.0000	37323.0000	(28a)
GF-Wall	458.8000	91.4900	367.3100	0.1800	66.1158	0.0000	0.0000	(29a)
Pitch Roof-1	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000	(30)
Pitch Roof-2	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000	(30)
Pitch Roof-3	170.7000		170.7000	0.1300	22.1910	0.0000	0.0000	(30)
Pitch Roof-4	162.3000		162.3000	0.1300	21.0990	0.0000	0.0000	(30)
Flat Roof-1	43.0000		43.0000	0.1300	5.5900	0.0000	0.0000	(30)
Total net area of external elements Aum (A, m <sup>2</sup> )			1253.3000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	272.2227		(33)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	37323.0000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K								79.5630 (35)
List of Thermal Bridges								

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	42.2300	0.0000	0.0000
E3 Sill	40.2800	0.0000	0.0000
E4 Jamb	83.0000	0.0000	0.0000
E5 Ground floor (normal)	142.9000	0.0000	0.0000
E16 Corner (normal)	12.5600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 0.0000 (36)  
 Point Thermal bridges = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 272.2227 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	192.0022	189.5718	187.1413	174.9893	172.5589	160.4069	160.4069	157.9765	165.2677	172.5589	177.4197	182.2805 (38)
Average = Sum(38)m / 12 =	464.2248	461.7944	459.3640	447.2120	444.7816	432.6296	432.6296	430.1991	437.4904	444.7816	449.6424	454.5032 (39)
HLP	0.9896	0.9844	0.9792	0.9533	0.9482	0.9223	0.9223	0.9171	0.9326	0.9482	0.9585	0.9689 (40)
HLP (average)												0.9520
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.3518 (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	0.0000 (42a)
Hot water usage for baths	92.7981	91.4199	89.4792	85.9007	83.2212	80.2501	78.6453	80.5725	82.6708	85.8500	89.5021	92.4844	(42b)
Hot water usage for other uses	48.9554	47.1752	45.3950	43.6148	41.8346	40.0544	40.0544	41.8346	43.6148	45.3950	47.1752	48.9554	(42c)
Average daily hot water use (litres/day)													130.5434 (43)
Daily hot water use	141.7535	138.5951	134.8741	129.5155	125.0558	120.3045	118.6997	122.4070	126.2856	131.2450	136.6773	141.4398	(44)
Energy content (annual)	224.5029	197.3576	207.2965	177.3003	168.3492	147.9284	143.5569	151.5655	155.7228	178.0982	194.7219	221.4605	(45)
Distribution loss (46)m = 0.15 x (45)m	33.6754	29.6036	31.0945	26.5950	25.2524	22.1893	21.5335	22.7348	23.3584	26.7147	29.2083	33.2191	(46)
Water storage loss:													250.0000 (47)
Store volume													1.5000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.8100 (55)
Enter (49) or (54) in (55)													
Total storage loss	25.1100	22.6800	25.1100	24.3000	25.1100	24.3000	25.1100	25.1100	24.3000	25.1100	24.3000	25.1100	(56)
If cylinder contains dedicated solar storage	25.1100	22.6800	25.1100	24.3000	25.1100	24.3000	25.1100	25.1100	24.3000	25.1100	24.3000	25.1100	(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	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329	(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	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329	(64)
12Total per year (kWh/year)													2737.4067 (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	113.3451	100.5744	107.6240	96.4019	94.6740	86.6358	86.4306	89.0934	89.2274	97.9156	102.1946	112.3335	(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	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	295.1811	326.8076	295.1811	305.0204	295.1811	305.0204	295.1811	295.1811	305.0204	295.1811	305.0204	295.1811	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	584.1490	590.2107	574.9355	542.4166	501.3672	462.7866	437.0124	430.9508	446.2259	478.7449	519.7942	558.3748	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	(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)	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	(71)
Water heating gains (Table 5)	152.3456	149.6642	144.6559	133.8916	127.2500	120.3275	116.1702	119.7493	123.9270	131.6070	141.9370	150.9859	(72)
Total internal gains	1107.9521	1142.9589	1091.0489	1057.6050	1000.0747	961.4110	921.6401	919.1575	948.4497	981.8093	1043.0280	1080.8182	(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	23.4300	10.6334	0.6000	0.8000	0.7700	82.8741 (74)						
East	20.5000	19.6403	0.6000	0.8000	0.7700	133.9293 (76)						
South	27.4900	46.7521	0.6000	0.8000	0.7700	427.5137 (78)						
West	15.9700	19.6403	0.6000	0.8000	0.7700	104.3342 (80)						
Solar gains	748.6512	1324.6278	1928.5870	2559.7750	3004.6993	3038.7219	2906.8010	2569.4845	2147.9793	1496.7717	906.0719	634.4354 (83)
Total gains	1856.6033	2467.5867	3019.6359	3617.3800	4004.7740	4000.1329	3828.4411	3488.6420	3096.4291	2478.5810	1949.0999	1715.2536 (84)



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	10015.8428 (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	5251.9786	0.1548	813.0555 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1219.8782	0.1410	171.9469 (264)
Space and water heating			985.0024 (265)
Pumps, fans and electric keep-hot	3019.0075	0.1387	418.7736 (267)
Energy for lighting	524.9785	0.1443	75.7706 (268)
Total CO2, kg/year			1479.5466 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.1500 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	5251.9786	1.5731	8262.0314 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1219.8782	1.5212	1855.6785 (278)
Space and water heating			10117.7099 (279)
Pumps, fans and electric keep-hot	3019.0075	1.5128	4567.1546 (281)
Energy for lighting	524.9785	1.5338	805.2295 (282)
Total Primary energy kWh/year			15490.0940 (286)
Dwelling Primary energy Rate (DPER)			33.0200 (287)

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF TARGET EMISSIONS  
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-----  
1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	469.1000 (1b)	x 3.1400 (2b)	= 1472.9740 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	469.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1472.9740 (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)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0272 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.2772 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2772 (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 infltr rate	0.3534	0.3464	0.3395	0.3049	0.2979	0.2633	0.2633	0.2564	0.2772	0.2979	0.3118	0.3257 (22b)
Effective ac	0.5624	0.5600	0.5576	0.5465	0.5444	0.5347	0.5347	0.5329	0.5384	0.5444	0.5486	0.5530 (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			4.1000	1.0000	4.1000		(26)
TER Opening Type (Uw = 1.20)			87.3900	1.1450	100.0649		(27)

Heatloss Floor 1				339.3000	0.1300	44.1090	(28a)
GF-Wall	458.8000	91.4900		367.3100	0.1800	66.1158	(29a)
Pitch Roof-1	39.6000			39.6000	0.1100	4.3560	(30)
Pitch Roof-2	39.6000			39.6000	0.1100	4.3560	(30)
Pitch Roof-3	170.7000			170.7000	0.1100	18.7770	(30)
Pitch Roof-4	162.3000			162.3000	0.1100	17.8530	(30)
Flat Roof-1	43.0000			43.0000	0.1100	4.7300	(30)
Total net area of external elements Aum(A, m2)				1253.3000			(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =		264.4617	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 79.5630 (35)

List of Thermal Bridges

K1 Element					Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate					42.2300	0.0500	2.1115
E3 Sill					40.2800	0.0500	2.0140
E4 Jamb					83.0000	0.0500	4.1500
E5 Corner (masonry)					142.9000	0.1600	22.8640
E6 Window (masonry)					12.5600	0.0900	1.1304

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 32.2699 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 296.7316 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	273.3899	272.2115	271.0563	265.6305	264.6154	259.8897	259.8897	259.0146	261.7100	264.6154	266.6690	268.8160	(38)
Heat transfer coeff	570.1215	568.9430	567.7879	562.3621	561.3470	556.6213	556.6213	555.7462	558.4416	561.3470	563.4006	565.5476	(39)
Average = Sum(39)m / 12 =												562.3573	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	1.2154	1.2128	1.2104	1.1988	1.1966	1.1866	1.1866	1.1847	1.1905	1.1966	1.2010	1.2056	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3518 (42)

Hot water usage for mixer showers 0.0000 (42a)

Hot water usage for baths 92.7981 91.4199 89.4792 85.9007 83.2212 80.2501 78.6453 80.5725 82.6708 85.8500 89.5021 92.4844 (42b)

Hot water usage for other uses 48.9554 47.1752 45.3950 43.6148 41.8346 40.0544 40.0544 41.8346 43.6148 45.3950 47.1752 48.9554 (42c)

Average daily hot water use (litres/day) 130.5434 (43)

Daily hot water use

Energy content (annual) 224.5029 197.3576 207.2965 177.3003 168.3492 147.9284 143.5569 151.5655 155.7228 178.0982 194.7219 221.4605 (45)

Distribution loss (46)m = 0.15 x (45)m 33.6754 29.6036 31.0945 26.5950 25.2524 22.1893 21.5335 22.7348 23.3584 26.7147 29.2083 33.2191 (46)

Water storage loss: Store volume 250.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.8903 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.0208 (55)

Total storage loss 31.6444 28.5820 31.6444 30.6236 31.6444 30.6236 31.6444 31.6444 30.6236 31.6444 30.6236 31.6444 (56)

If cylinder contains dedicated solar storage 31.6444 28.5820 31.6444 30.6236 31.6444 30.6236 31.6444 31.6444 30.6236 31.6444 30.6236 31.6444 (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 279.4097 246.9508 262.2033 230.4359 223.2560 201.0640 198.4637 206.4723 208.8584 233.0050 247.8575 276.3673 (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 279.4097 246.9508 262.2033 230.4359 223.2560 201.0640 198.4637 206.4723 208.8584 233.0050 247.8575 276.3673 (64)

12Total per year (kWh/year) 2814.3439 (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 118.5726 105.2960 112.8515 101.4608 99.9015 91.6947 91.6581 94.3210 94.2863 103.1431 107.2535 117.5610 (65)

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

Metabolic gains (Table 5), Watts

(66)m 167.5880 167.5880 167.5880 167.5880 167.5880 167.5880 167.5880 167.5880 167.5880 167.5880 167.5880 167.5880 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 299.3597 331.4340 299.3597 309.3384 299.3597 309.3384 299.3597 299.3597 309.3384 299.3597 309.3384 299.3597 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 584.1490 590.2107 574.9355 542.4166 501.3672 462.7866 437.0124 430.9508 446.2259 478.7449 519.7942 558.3748 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 39.7588 39.7588 39.7588 39.7588 39.7588 39.7588 39.7588 39.7588 39.7588 39.7588 39.7588 39.7588 (69)

Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 0.0000 0.0000 0.0000 0.0000 0.0000 3.0000 3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5) -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 (71)

Water heating gains (Table 5) 159.3718 156.6904 151.6822 140.9178 134.2763 127.3537 123.1964 126.7755 130.9532 138.6332 148.9632 158.0122 (72)

Total internal gains 1119.1569 1154.6115 1102.2538 1068.9491 1011.2796 972.7551 932.8449 930.3624 959.7939 993.0142 1054.3722 1092.0231 (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	23.4300	10.6334	0.6300	0.7000	0.7700	76.1405 (74)
East	20.5000	19.6403	0.6300	0.7000	0.7700	123.0476 (76)
South	27.4900	46.7521	0.6300	0.7000	0.7700	392.7782 (78)
West	15.9700	19.6403	0.6300	0.7000	0.7700	95.8570 (80)

Solar gains	687.8233	1217.0018	1771.8893	2351.7933	2760.5675	2791.8257	2670.6234	2360.7139	1973.4560	1375.1590	832.4536	582.8875 (83)
Total gains	1806.9803	2371.6132	2874.1431	3420.7424	3771.8471	3764.5809	3603.4684	3291.0763	2933.2499	2368.1732	1886.8258	1674.9106 (84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	18.1847	18.2224	18.2595	18.4356	18.4690	18.6258	18.6258	18.6551	18.6551	18.4690	18.4016	18.3318
alpha	2.2123	2.2148	2.2173	2.2290	2.2313	2.2417	2.2417	2.2437	2.2377	2.2313	2.2268	2.2221
util living area	0.9794	0.9623	0.9347	0.8796	0.7933	0.6722	0.5514	0.6009	0.7789	0.9161	0.9678	0.9825 (86)
MIT	17.2548	17.6737	18.3150	19.1542	19.9156	20.4959	20.7741	20.7170	20.2348	19.2146	18.0824	17.1901 (87)
Th 2	19.9077	19.9097	19.9117	19.9210	19.9227	19.9308	19.9308	19.9323	19.9276	19.9227	19.9192	19.9155 (88)
util rest of house	0.9764	0.9570	0.9250	0.8604	0.7569	0.6061	0.4508	0.5036	0.7262	0.8989	0.9623	0.9800 (89)
MIT 2	15.4910	16.0239	16.8368	17.8923	18.8240	19.5013	19.7870	19.7406	19.2245	17.9859	16.5522	15.4113 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	16.1562	16.6460	17.3942	18.3682	19.2357	19.8764	20.1592	20.1088	19.6055	18.4492	17.1292	16.0821 (92)
Temperature adjustment												0.0000
adjusted MIT	16.1562	16.6460	17.3942	18.3682	19.2357	19.8764	20.1592	20.1088	19.6055	18.4492	17.1292	16.0821 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9599	0.9326	0.8931	0.8246	0.7291	0.6023	0.4742	0.5214	0.7072	0.8663	0.9404	0.9653 (94)
Useful gains	1734.4340	2211.6504	2566.8103	2820.8369	2750.0139	2267.4875	1708.6509	1715.9125	2074.4637	2051.4832	1774.2827	1616.8748 (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	6759.4601	6682.8282	6185.6151	5324.5592	4230.1292	2936.9522	1981.1421	2061.1524	3074.4950	4406.1361	5650.4835	6719.8816 (97)
Space heating kWh	3738.6194	3004.6315	2692.3908	1802.6800	1101.2058	0.0000	0.0000	0.0000	0.0000	1751.8618	2790.8646	3796.6371 (98a)
Space heating requirement - total per year (kWh/year)												20678.8910
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	3738.6194	3004.6315	2692.3908	1802.6800	1101.2058	0.0000	0.0000	0.0000	0.0000	1751.8618	2790.8646	3796.6371 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												20678.8910
Space heating per m2												(98c) / (4) = 44.0821 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	3738.6194	3004.6315	2692.3908	1802.6800	1101.2058	0.0000	0.0000	0.0000	0.0000	1751.8618	2790.8646	3796.6371 (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)	4050.5085	3255.2887	2916.9998	1953.0661	1193.0724	0.0000	0.0000	0.0000	0.0000	1898.0084	3023.6886	4113.3663 (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	279.4097	246.9508	262.2033	230.4359	223.2560	201.0640	198.4637	206.4723	208.8584	233.0050	247.8575	276.3673 (64)
Efficiency of water heater (217)m	88.1090	88.0458	87.9200	87.6792	87.1433	79.8000	79.8000	79.8000	79.8000	87.6397	87.9906	79.8000 (216)
Fuel for water heating, kWh/month	317.1182	280.4798	298.2293	262.8170	256.1940	251.9599	248.7014	258.7372	261.7273	265.8670	281.6865	313.6061 (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	62.2010	49.9000	44.9294	32.9172	25.4262	20.7734	23.1946	30.1493	39.1609	51.3812	58.0350	63.9298 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-255.1520	-295.0953	-348.3463	-318.9730	-292.2387	-255.2802	-250.8887	-258.7162	-271.1465	-293.2223	-255.3893	-228.8936 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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)	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)	-431.7028	-845.3079	-1577.9615	-2238.5742	-2845.7329	-2820.7643	-2788.3578	-2411.2981	-1838.2014	-1160.3669	-558.1972	-346.6358 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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)	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												22403.9989 (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	3297.1238	(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)	501.9980	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-23186.4428	(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 used	-0.0000	(236)
Total delivered energy for all uses	3102.6779	(238)

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 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	22403.9989	0.2100	4704.8398 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3297.1238	0.2100	692.3960 (264)
Space and water heating			5397.2358 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	501.9980	0.1443	72.4538 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3323.3421	0.1392	-462.5807
PV Unit electricity exported	-19863.1007	0.1277	-2535.7029
Total			-2998.2836 (269)
Total CO2, kg/year			2483.3352 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			5.2900 (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	22403.9989	1.1300	25316.5187 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3297.1238	1.1300	3725.7499 (278)
Space and water heating			29042.2687 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	501.9980	1.5338	769.9813 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3323.3421	1.5147	-5033.7522
PV Unit electricity exported	-19863.1007	0.4687	-9309.1768
Total			-14342.9290 (283)
Total Primary energy kWh/year			15599.4217 (286)
Target Primary Energy Rate (TPER)			33.2500 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF FABRIC ENERGY EFFICIENCY  
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-----  
 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	469.1000 (1b)	x 3.1400 (2b)	= 1472.9740 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	469.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1472.9740 (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) = 0.0272 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2272 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)



Infiltration rate adjusted to include shelter factor

$$(21) = (18) \times (20) = 0.2272 \quad (21)$$

	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	0.2896	0.2839	0.2783	0.2499	0.2442	0.2158	0.2158	0.2101	0.2272	0.2442	0.2556	0.2669 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.5419	0.5403	0.5387	0.5312	0.5298	0.5233	0.5233	0.5221	0.5258	0.5298	0.5327	0.5356 (25)

## Thermal Mass Calculation Summary



### Parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window-New (Uw = 1.20)			87.3900	1.1450	100.0649		(27)
Door			4.1000	1.5000	6.1500		(26)
Heatloss Floor 1			339.3000	0.1200	40.7160	110.0000	37323.0000 (28a)
GF-Wall	458.8000	91.4900	367.3100	0.1800	66.1158	0.0000	0.0000 (29a)
Pitch Roof-1	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000 (30)
Pitch Roof-2	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000 (30)
Pitch Roof-3	170.7000		170.7000	0.1300	22.1910	0.0000	0.0000 (30)
Pitch Roof-4	162.3000		162.3000	0.1300	21.0990	0.0000	0.0000 (30)
Flat Roof-1	43.0000		43.0000	0.1300	5.5900	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			1253.3000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 272.2227		(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 37323.0000 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 79.5630 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	42.2300	0.0000	0.0000
E3 Sill	40.2800	0.0000	0.0000
E4 Jamb	83.0000	0.0000	0.0000
E5 Ground floor (normal)	142.9000	0.0000	0.0000
E16 Corner (normal)	12.5600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 0.0000 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 272.2227 (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	263.4274	262.6358	261.8598	258.2151	257.5332	254.3588	254.3588	253.7710	255.5816	257.5332	258.9127	260.3549 (38)
Heat transfer coeff	535.6501	534.8585	534.0825	530.4378	529.7559	526.5815	526.5815	525.9937	527.8043	529.7559	531.1354	532.5776 (39)
Average = Sum(39)m / 12 =												530.4346

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1419	1.1402	1.1385	1.1308	1.1293	1.1225	1.1225	1.1213	1.1251	1.1293	1.1322	1.1353 (40)
HLP (average)												1.1307
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.3518 (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	34.7056	34.1901	33.4643	32.1260	31.1239	30.0127	29.4125	30.1333	30.9181	32.1071	33.4729	34.5882 (42b)
Hot water usage for other uses	48.9554	47.1752	45.3950	43.6148	41.8346	40.0544	40.0544	41.8346	43.6148	45.3950	47.1752	48.9554 (42c)
Average daily hot water use (litres/day)												76.6824 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	83.6609	81.3653	78.8593	75.7408	72.9585	70.0671	69.4669	71.9679	74.5329	77.5020	80.6481	83.5436 (44)
Energy conte	132.4985	115.8631	121.2038	103.6854	98.2162	86.1557	84.0142	89.1113	91.9065	105.1695	114.8980	130.8091 (45)
Energy content (annual)												Total = Sum(45)m = 1273.5314
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	112.6237	98.4837	103.0232	88.1326	83.4838	73.2324	71.4121	75.7446	78.1205	89.3941	97.6633	111.1877 (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	112.6237	98.4837	103.0232	88.1326	83.4838	73.2324	71.4121	75.7446	78.1205	89.3941	97.6633	111.1877 (64)
Total per year (kWh/year)												1082.5017 (64)
Electric shower(s)	64.4014	57.3822	62.6591	59.7948	60.9169	58.1088	60.0457	60.9169	59.7948	62.6591	61.4809	64.4014 (64a)
Heat gains from water heating, kWh/month	44.2563	38.9665	41.4206	36.9819	36.1002	32.8353	32.8645	34.1654	34.4788	38.0133	39.7860	43.8973 (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	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	295.1811	326.8076	295.1811	305.0204	295.1811	305.0204	295.1811	295.1811	305.0204	295.1811	305.0204	295.1811 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	584.1490	590.2107	574.9355	542.4166	501.3672	462.7866	437.0124	430.9508	446.2259	478.7449	519.7942	558.3748 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588 (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)	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704 (71)
Water heating gains (Table 5)	59.4842	57.9858	55.6728	51.3637	48.5217	45.6046	44.1727	45.9212	47.8873	51.0932	55.2584	59.0017 (72)
Total internal gains	1012.0907	1048.2804	999.0658	972.0771	918.3464	886.6880	849.6426	845.3294	872.4100	898.2955	953.3494	985.8340 (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			23.4300	10.6334	0.6000	0.8000		0.7700		82.8741 (74)		
East			20.5000	19.6403	0.6000	0.8000		0.7700		133.9293 (76)		
South			27.4900	46.7521	0.6000	0.8000		0.7700		427.5137 (78)		
West			15.9700	19.6403	0.6000	0.8000		0.7700		104.3342 (80)		
Solar gains	748.6512	1324.6278	1928.5870	2559.7750	3004.6993	3038.7219	2906.8010	2569.4845	2147.9793	1496.7717	906.0719	634.4354 (83)
Total gains	1760.7420	2372.9082	2927.6528	3531.8521	3923.0457	3925.4099	3756.4436	3414.8139	3020.3894	2395.0672	1859.4214	1620.2694 (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	19.3550	19.3836	19.4118	19.5452	19.5703	19.6883	19.6883	19.7103	19.6427	19.5703	19.5195	19.4666
alpha	2.2903	2.2922	2.2941	2.3030	2.3047	2.3126	2.3126	2.3140	2.3095	2.3047	2.3013	2.2978
util living area	0.9805	0.9617	0.9304	0.8680	0.7722	0.6434	0.5199	0.5719	0.7601	0.9115	0.9683	0.9838 (86)
MIT	17.4105	17.8508	18.5004	19.3256	20.0518	20.5767	20.8177	20.7660	20.3262	19.3377	18.2137	17.3341 (87)
Th 2	19.9668	19.9682	19.9695	19.9758	19.9770	19.9825	19.9825	19.9835	19.9804	19.9770	19.9746	19.9721 (88)
util rest of house	0.9778	0.9564	0.9205	0.8482	0.7352	0.5789	0.4257	0.4793	0.7073	0.8941	0.9631	0.9815 (89)
MIT 2	16.6500	17.0873	17.7295	18.5377	19.2271	19.7008	19.8912	19.8591	19.4961	18.5647	17.4553	16.5773 (90)
Living area fraction									fLA = Living area / (4) =			0.3771 (91)
MIT	16.9368	17.3752	18.0202	18.8348	19.5381	20.0311	20.2406	20.2011	19.8091	18.8562	17.7413	16.8627 (92)
Temperature adjustment												0.0000
adjusted MIT	16.9368	17.3752	18.0202	18.8348	19.5381	20.0311	20.2406	20.2011	19.8091	18.8562	17.7413	16.8627 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9657	0.9377	0.8956	0.8211	0.7169	0.5822	0.4512	0.5008	0.6970	0.8692	0.9467	0.9711 (94)
Useful gains	1700.4000	2225.0407	2621.9052	2899.8827	2812.6046	2285.4853	1695.0221	1710.1515	2105.2714	2081.8078	1760.2929	1573.3723 (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	6768.9008	6672.4768	6152.7336	5269.8156	4152.2632	2859.9356	1917.0652	1999.3560	3013.2953	4373.7763	5651.9560	6743.8801 (97)
Space heating kWh	3770.9646	2988.6771	2626.9364	1706.3517	996.7060	0.0000	0.0000	0.0000	0.0000	1705.2245	2801.9974	3846.8578 (98a)
Space heating requirement - total per year (kWh/year)												20443.7155
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	3770.9646	2988.6771	2626.9364	1706.3517	996.7060	0.0000	0.0000	0.0000	0.0000	1705.2245	2801.9974	3846.8578 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												20443.7155
Space heating per m2										(98c) / (4) =		43.5807 (99)

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	4949.8663	3896.7032	3997.5519	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6593	0.7276	0.6854	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	3263.5054	2835.2002	2739.9350	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	4439.4085	4247.3944	3854.1972	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	846.6502	1050.6724	829.0111	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	211.6626	262.6681	207.2528	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												681.5834 (107)
Energy for space heating												43.5807 (99)
Energy for space cooling												1.4530 (108)
Total												45.0337 (109)
Fabric Energy Efficiency (DFEE)												45.0 (109)

1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	469.1000 (1b)	3.1400 (2b)	1472.9740 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	469.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	1472.9740 (5)

2. Ventilation rate

	m <sup>3</sup> 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =											0.0272 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												5.0000 (17)
Infiltration rate												0.2772 (18)
Number of sides sheltered												0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =											1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.2772 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
Effective ac	0.3534	0.3464	0.3395	0.3049	0.2979	0.2633	0.2633	0.2564	0.2772	0.2979	0.3118	0.3257 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5624	0.5600	0.5576	0.5465	0.5444	0.5347	0.5347	0.5329	0.5384	0.5444	0.5486	0.5530 (25)

3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
TER Opaque door			4.1000	1.0000	4.1000		(26)					
TER Opening Type (Uw = 1.20)			87.3900	1.1450	100.0649		(27)					
Heatloss Floor 1			339.3000	0.1300	44.1090		(28a)					
GF-Wall	458.8000	91.4900	367.3100	0.1800	66.1158		(29a)					
Pitch Roof-1	39.6000		39.6000	0.1100	4.3560		(30)					
Pitch Roof-2	39.6000		39.6000	0.1100	4.3560		(30)					
Pitch Roof-3	170.7000		170.7000	0.1100	18.7770		(30)					
Pitch Roof-4	162.3000		162.3000	0.1100	17.8530		(30)					
Flat Roof-1	43.0000		43.0000	0.1100	4.7300		(30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			1253.3000				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	264.4617	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							79.5630 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E1 Steel lintel with perforated steel base plate				42.2300	0.0500	2.1115						
E3 Sill				40.2800	0.0500	2.0140						
E4 Jamb				83.0000	0.0500	4.1500						
E5 Ground floor (normal)				142.9000	0.1600	22.8640						
E16 Corner (normal)				12.5600	0.0900	1.1304						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							32.2699 (36)					
Point Thermal bridges							(36a) = 0.0000					
Total fabric heat loss							(33) + (36) + (36a) = 296.7316 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	273.3899	272.2115	271.0563	265.6305	264.6154	259.8897	259.8897	259.0146	261.7100	264.6154	266.6690	268.8160 (38)
Average = Sum(39)m / 12 =	570.1215	568.9430	567.7879	562.3621	561.3470	556.6213	556.6213	555.7462	558.4416	561.3470	563.4006	565.5476 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2154	1.2128	1.2104	1.1988	1.1966	1.1866	1.1866	1.1847	1.1905	1.1966	1.2010	1.2056 (40)
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	3.3518 (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	34.7056	34.1901	33.4643	32.1260	31.1239	30.0127	29.4125	30.1333	30.9181	32.1071	33.4729	34.5882 (42b)
Hot water usage for other uses	48.9554	47.1752	45.3950	43.6148	41.8346	40.0544	40.0544	41.8346	43.6148	45.3950	47.1752	48.9554 (42c)
Average daily hot water use (litres/day)	76.6824 (43)											

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	83.6609	81.3653	78.8593	75.7408	72.9585	70.0671	69.4669	71.9679	74.5329	77.5020	80.6481	83.5436	(44)
Energy content	132.4985	115.8631	121.2038	103.6854	98.2162	86.1557	84.0142	89.1113	91.9065	105.1695	114.8980	130.8091	(45)
Energy content (annual)	Total = Sum(45)m =											1273.5314	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
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	(59)
Total heat required for water heating calculated for each month	112.6237	98.4837	103.0232	88.1326	83.4838	73.2324	71.4121	75.7446	78.1205	89.3941	97.6633	111.1877	(62)
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	(63a)
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	(63b)
Output from w/h	112.6237	98.4837	103.0232	88.1326	83.4838	73.2324	71.4121	75.7446	78.1205	89.3941	97.6633	111.1877	(64)
Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											1082.5017	
Electric shower(s)	64.4014	57.3822	62.6591	59.7948	60.9169	58.1088	60.0457	60.9169	59.7948	62.6591	61.4809	64.4014	(64a)
Heat gains from water heating, kWh/month	44.2563	38.9665	41.4206	36.9819	36.1002	32.8353	32.8645	34.1654	34.4788	38.0133	39.7860	43.8973	(65)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												732.5620	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	167.5880	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	299.3597	331.4340	299.3597	309.3384	299.3597	309.3384	299.3597	299.3597	309.3384	299.3597	309.3384	299.3597	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	584.1490	590.2107	574.9355	542.4166	501.3672	462.7866	437.0124	430.9508	446.2259	478.7449	519.7942	558.3748	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	39.7588	(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)	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	(71)
Water heating gains (Table 5)	59.4842	57.9858	55.6728	51.3637	48.5217	45.6046	44.1727	45.9212	47.8873	51.0932	55.2584	59.0017	(72)
Total internal gains	1016.2694	1052.9068	1003.2445	976.3950	922.5251	891.0060	853.8212	849.5081	876.7280	902.4741	957.6674	990.0126	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g Specific data or Table 6c	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	23.4300	10.6334	0.6300	0.7700	0.7700	76.1405	(74)						
East	20.5000	19.6403	0.6300	0.7700	0.7700	123.0476	(76)						
South	27.4900	46.7521	0.6300	0.7700	0.7700	392.7782	(78)						
West	15.9700	19.6403	0.6300	0.7700	0.7700	95.8570	(80)						
Solar gains	687.8233	1217.0018	1771.8893	2351.7933	2760.6234	2791.8257	2670.6234	2360.7139	1973.4560	1375.1590	832.4536	582.8875	(83)
Total gains	1704.0927	2269.9086	2775.1338	3328.1883	3683.0925	3682.8317	3524.4446	3210.2220	2850.1840	2277.6331	1790.1210	1572.9002	(84)

#### 7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	18.1847	18.2224	18.2595	18.4356	18.4690	18.6258	18.6258	18.6551	18.5651	18.4690	18.4016	18.3318	
alpha	2.2123	2.2148	2.2173	2.2290	2.2313	2.2417	2.2417	2.2437	2.2377	2.2313	2.2268	2.2221	
util living area	0.9817	0.9654	0.9387	0.8848	0.8000	0.6799	0.5596	0.6100	0.7873	0.9216	0.9709	0.9846	(86)
MIT	17.2080	17.6297	18.2755	19.1231	19.8933	20.4830	20.7669	20.7076	20.2149	19.1803	18.0396	17.1431	(87)
Th 2	19.9077	19.9097	19.9117	19.9210	19.9227	19.9308	19.9308	19.9323	19.9276	19.9227	19.9192	19.9155	(88)
util rest of house	0.9790	0.9604	0.9295	0.8662	0.7642	0.6142	0.4586	0.5126	0.7356	0.9053	0.9659	0.9824	(89)
MIT 2	16.4145	16.8340	17.4740	18.3091	19.0461	19.5861	19.8146	19.7771	19.3628	18.3793	17.2503	16.3544	(90)
Living area fraction	FLA = Living area / (4) =											0.3771	(91)
MIT	16.7137	17.1341	17.7763	18.6161	19.3655	19.9243	20.1737	20.1280	19.6841	18.6814	17.5480	16.6518	(92)
Temperature adjustment													
adjusted MIT	16.7137	17.1341	17.7763	18.6161	19.3655	19.9243	20.1737	20.1280	19.6841	18.6814	17.5480	16.6518	(93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9671	0.9421	0.9048	0.8378	0.7423	0.6137	0.4835	0.5324	0.7216	0.8800	0.9498	0.9720	(94)
Useful gains	1648.0754	2138.4479	2510.8693	2788.4306	2733.9286	2260.2355	1704.1990	1709.1492	2056.6737	2004.3721	1700.2378	1528.8647	(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	7077.3244	6960.4870	6402.5248	5463.9534	4303.0283	2963.6371	1989.2015	2071.8152	3118.4019	4536.4533	5886.3954	7042.1065	(97)
Space heating kWh	4039.3612	3240.4103	2895.3917	1926.3764	1167.4101	0.0000	0.0000	0.0000	0.0000	1883.8684	3014.0335	4101.8519	(98a)
Space heating requirement - total per year (kWh/year)												22268.7036	
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	4039.3612	3240.4103	2895.3917	1926.3764	1167.4101	0.0000	0.0000	0.0000	0.0000	1883.8684	3014.0335	4101.8519 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												22268.7036
Space heating per m2												(98c) / (4) = 47.4711 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	5232.2404	4118.9977	4223.6711	0.0000	0.0000	0.0000	0.0000 (100)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	0.6085	0.6788	0.6360	0.0000	0.0000	0.0000	0.0000 (101)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	3183.8855	2796.1490	2686.1428	0.0000	0.0000	0.0000	0.0000 (102)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	4151.1942	3971.7377	3610.6931	0.0000	0.0000	0.0000	0.0000 (103)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (104)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	696.4623	874.6380	687.8654	0.0000	0.0000	0.0000	0.0000 (105)
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	174.1156	218.6595	171.9664	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												564.7414 (107)
Energy for space cooling												47.4711 (99)
Total												1.2039 (108)
Fabric Energy Efficiency (TFEE)												48.6750 (109)
												48.7 (109)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	469.1000 (1b)	3.1400 (2b)	1472.9740 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	469.1000		1472.9740 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 1472.9740 (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)
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	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2000 (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	0.2550	0.2500	0.2450	0.2200	0.2150	0.1900	0.1900	0.1850	0.2000	0.2150	0.2250	0.2350 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												72.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.3950	0.3900	0.3850	0.3600	0.3550	0.3300	0.3300	0.3250	0.3400	0.3550	0.3650	0.3750 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window-New (Uw = 1.20)			87.3900	1.1450	100.0649		(27)
Door			4.1000	1.5000	6.1500		(26)
Heatloss Floor 1			339.3000	0.1200	40.7160	110.0000	37323.0000 (28a)
GF-Wall	458.8000	91.4900	367.3100	0.1800	66.1158	0.0000	0.0000 (29a)
Pitch Roof-1	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000 (30)
Pitch Roof-2	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000 (30)
Pitch Roof-3	170.7000		170.7000	0.1300	22.1910	0.0000	0.0000 (30)
Pitch Roof-4	162.3000		162.3000	0.1300	21.0990	0.0000	0.0000 (30)

Flat Roof-1 43.0000 43.0000 0.1300 5.5900 0.0000 0.0000 (30)  
 Total net area of external elements Aum(A, m2) 1253.3000 (31)  
 Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 272.2227 (33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 37323.0000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 79.5630 (35)

List of Thermal Bridges  
 K1 Element Length Psi-value Total  
 E1 Steel lintel with perforated steel base plate 42.2300 0.0000 0.0000  
 E3 Sill 40.2800 0.0000 0.0000  
 E4 Jamb 83.0000 0.0000 0.0000  
 E5 Ground floor (normal) 142.9000 0.0000 0.0000  
 E16 Corner (normal) 12.5600 0.0000 0.0000  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 0.0000 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 272.2227 (37)

Επιλέξιμο Σύστημα Φύλισης

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)  
 (38)m 192.0022 189.5718 187.1413 174.9893 172.5589 160.4069 160.4069 157.9765 165.2677 172.5589 177.4197 182.2805 (38)  
 Heat transfer coeff 464.2248 461.7944 459.3640 447.2120 444.7816 432.6296 432.6296 430.1991 437.4904 444.7816 449.6424 454.5032 (39)  
 Average = Sum(39)m / 12 = 446.6044

HLP 0.9896 0.9844 0.9792 0.9533 0.9482 0.9223 0.9223 0.9171 0.9326 0.9482 0.9585 0.9689 (40)  
 HLP (average) 0.9520  
 Days in mont 31 28 31 30 31 30 31 31 30 31 30 31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3518 (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 92.7981 91.4199 89.4792 85.9007 83.2212 80.2501 78.6453 80.5725 82.6708 85.8500 89.5021 92.4844 (42b)  
 Hot water usage for other uses 48.9554 47.1752 45.3950 43.6148 41.8346 40.0544 40.0544 41.8346 43.6148 45.3950 47.1752 48.9554 (42c)  
 Average daily hot water use (litres/day) 130.5434 (43)  
 Daily hot water use  
 Jan 141.7535 138.5951 134.8741 129.5155 125.0558 120.3045 118.6997 122.4070 126.2856 131.2450 136.6773 141.4398 (44)  
 Energy conte 224.5029 197.3576 207.2965 177.3003 168.3492 147.9284 143.5569 151.5655 155.7228 178.0982 194.7219 221.4605 (45)  
 Energy content (annual) Total = Sum(45)m = 2167.8607  
 Distribution loss (46)m = 0.15 x (45)m  
 33.6754 29.6036 31.0945 26.5950 25.2524 22.1893 21.5335 22.7348 23.3584 26.7147 29.2083 33.2191 (46)  
 Water storage loss:  
 Store volume 250.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day):  
 Temperature factor from Table 2b 1.5000 (48)  
 Enter (49) or (54) in (55) 0.5400 (49)  
 Total storage loss 0.8100 (55)  
 25.1100 22.6800 25.1100 24.3000 25.1100 24.3000 25.1100 25.1100 24.3000 25.1100 24.3000 25.1100 (56)  
 If cylinder contains dedicated solar storage  
 25.1100 22.6800 25.1100 24.3000 25.1100 24.3000 25.1100 25.1100 24.3000 25.1100 24.3000 25.1100 (57)  
 Primary loss 23.2624 21.0112 23.2624 22.5120 22.5120 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  
 272.8753 241.0488 255.6689 224.1123 216.7216 194.7404 191.9293 199.9379 202.5348 226.4706 241.5339 269.8329 (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  
 272.8753 241.0488 255.6689 224.1123 216.7216 194.7404 191.9293 199.9379 202.5348 226.4706 241.5339 269.8329 (64)  
 Total per year (kWh/year) = Sum(64)m = 2737.4067 (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  
 113.3451 100.5744 107.6240 96.4019 94.6740 86.6358 86.4306 89.0934 89.2274 97.9156 102.1946 112.3335 (65)

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

Metabolic gains (Table 5), Watts  
 (66)m 201.1056 201.1056 201.1056 201.1056 201.1056 201.1056 201.1056 201.1056 201.1056 201.1056 201.1056 201.1056 (66)  
 Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  
 74.3161 66.0069 53.6804 40.6396 30.3785 25.6468 27.7123 36.0215 48.3480 61.3889 71.6499 76.3816 (67)  
 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  
 871.8642 880.9114 858.1127 809.5770 748.3093 690.7263 652.2574 643.2101 666.0089 714.5446 775.8123 833.3952 (68)  
 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  
 58.4623 58.4623 58.4623 58.4623 58.4623 58.4623 58.4623 58.4623 58.4623 58.4623 58.4623 58.4623 (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)  
 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 -134.0704 (71)  
 Water heating gains (Table 5)  
 152.3456 149.6642 144.6559 133.8916 127.2500 120.3275 116.1702 119.7493 123.9270 131.6070 141.9370 150.9859 (72)  
 Total internal gains  
 1227.0235 1225.0801 1184.9466 1112.6056 1034.4354 962.1982 921.6374 924.4784 963.7814 1036.0380 1117.8967 1189.2603 (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	23.4300	10.6334	0.6000	0.8000	0.7700	82.8741 (74)
East	20.5000	19.6403	0.6000	0.8000	0.7700	133.9293 (76)
South	27.4900	46.7521	0.6000	0.8000	0.7700	427.5137 (78)



Electricity for pumps and fans: (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 1.6800) mechanical ventilation fans (SFP = 1.6800)	3019.0075 (230a) 3019.0075 (231)
Total electricity for the above, kWh/year	524.9785 (232)
Electricity for lighting (calculated in Appendix L)	
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	9932.2382 (238)



10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5168.3740	16.4900	852.2649 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1219.8782	16.4900	201.1579 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	3019.0075	16.4900	497.8343 (249)
Energy for lighting	524.9785	16.4900	86.5690 (250)
Additional standing charges			0.0000 (251)
Total energy cost			1637.8261 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.1469 (257)
SAP value		81.4089
SAP rating (Section 12)		81 (258)
SAP band		B

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	5168.3740	0.1548	800.0399 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1219.8782	0.1410	171.9469 (264)
Space and water heating			971.9868 (265)
Pumps, fans and electric keep-hot	3019.0075	0.1387	418.7736 (267)
Energy for lighting	524.9785	0.1443	75.7706 (268)
Total CO2, kg/year			1466.5309 (272)
CO2 emissions per m2			3.1300 (273)
EI value			96.1775
EI rating			96 (274)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	469.1000 (1b)	x 3.1400 (2b)	= 1472.9740 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	469.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1472.9740 (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)
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	0 (19)



Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2000 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000 (22)
Wind factor	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750 (22a)
Adj infilt rate	0.3000	0.2800	0.2800	0.2500	0.2500	0.2200	0.2200	0.2150	0.2350	0.2700	0.2750	0.2950 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												72.0000 (23c)
Effective ac	0.4400	0.4200	0.4200	0.3900	0.3900	0.3600	0.3600	0.3550	0.3750	0.4100	0.4150	0.4350 (25)



### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window-New (Uw = 1.20)			87.3900	1.1450	100.0649		(27)
Door			4.1000	1.5000	6.1500		(26)
Heatloss Floor 1			339.3000	0.1200	40.7160	110.0000	37323.0000 (28a)
GF-Wall	458.8000	91.4900	367.3100	0.1800	66.1158	0.0000	0.0000 (29a)
Pitch Roof-1	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000 (30)
Pitch Roof-2	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000 (30)
Pitch Roof-3	170.7000		170.7000	0.1300	22.1910	0.0000	0.0000 (30)
Pitch Roof-4	162.3000		162.3000	0.1300	21.0990	0.0000	0.0000 (30)
Flat Roof-1	43.0000		43.0000	0.1300	5.5900	0.0000	0.0000 (30)
Total net area of external elements Aum (A, m2)			1253.3000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	272.2227	(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 37323.0000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 79.5630 (35)

List of Thermal Bridges	K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	42.2300	0.0000	0.0000	0.0000
E3 Sill	40.2800	0.0000	0.0000	0.0000
E4 Jamb	83.0000	0.0000	0.0000	0.0000
E5 Ground floor (normal)	142.9000	0.0000	0.0000	0.0000
E16 Corner (normal)	12.5600	0.0000	0.0000	0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				0.0000 (36)
Point Thermal bridges				(36a) = 0.0000
Total fabric heat loss				(33) + (36) + (36a) = 272.2227 (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	213.8758	204.1542	204.1542	189.5718	189.5718	174.9893	174.9893	172.5589	182.2805	199.2934	201.7238	211.4454 (38)
Heat transfer coeff	486.0985	476.3769	476.3769	461.7944	461.7944	447.2120	447.2120	444.7816	454.5032	471.5161	473.9465	483.6681 (39)
Average = Sum(39)m / 12 =												465.4400

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0362	1.0155	1.0155	0.9844	0.9844	0.9533	0.9533	0.9482	0.9689	1.0052	1.0103	1.0311 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy	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 (42)
Hot water usage for baths	92.7981	91.4199	89.4792	85.9007	83.2212	80.2501	78.6453	80.5725	82.6708	85.8500	89.5021	92.4844 (42b)
Hot water usage for other uses	48.9554	47.1752	45.3950	43.6148	41.8346	40.0544	40.0544	41.8346	43.6148	45.3950	47.1752	48.9554 (42c)
Average daily hot water use (litres/day)												130.5434 (43)
Daily hot water use	141.7535	138.5951	134.8741	129.5155	125.0558	120.3045	118.6997	122.4070	126.2856	131.2450	136.6773	141.4398 (44)
Energy conte	224.5029	197.3576	207.2965	177.3003	168.3492	147.9284	143.5569	151.5655	155.7228	178.0982	194.7219	221.4605 (45)
Energy content (annual)										Total = Sum(45)m =		2167.8607
Distribution loss (46)m = 0.15 x (45)m	33.6754	29.6036	31.0945	26.5950	25.2524	22.1893	21.5335	22.7348	23.3584	26.7147	29.2083	33.2191 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8100 (55)
Total storage loss	25.1100	22.6800	25.1100	24.3000	25.1100	24.3000	25.1100	25.1100	24.3000	25.1100	24.3000	25.1100 (56)
If cylinder contains dedicated solar storage												
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	25.1100 (57)
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 (59)
Total heat required for water heating calculated for each month	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329 (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 (64a)
Output from w/h	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329 (64)
										Total per year (kWh/year) = Sum(64)m =		2737.4067 (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	113.3451	100.5744	107.6240	96.4019	94.6740	86.6358	86.4306	89.0934	89.2274	97.9156	102.1946	112.3335 (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	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	74.3161	66.0069	53.6804	40.6396	30.3785	25.6468	27.7123	36.0215	48.3480	61.3889	71.6499	76.3816 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	871.8642	880.9114	858.1127	809.5770	748.3093	690.7263	652.2574	643.2101	666.0089	714.5446	775.8123	833.3952 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623 (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)												
	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704 (71)
Water heating gains (Table 5)												
	152.3456	149.6642	144.6559	133.8916	127.2500	120.3275	116.1702	119.7493	123.9270	131.6070	141.9370	150.9859 (72)
	122.7423	122.9301	1184.9466	1112.6056	1034.4354	962.1982	921.6374	924.4784	963.7814	1036.0380	1117.8967	1189.2603 (73)

6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
North	23.4300	14.1962	0.6000	0.8000	0.7700	110.6419 (74)						
East	20.5000	26.5726	0.6000	0.8000	0.7700	181.2020 (76)						
South	27.4900	59.2009	0.6000	0.8000	0.7700	541.3491 (78)						
West	15.9700	26.5726	0.6000	0.8000	0.7700	141.1608 (80)						
Solar gains	974.3539	1458.5480	2126.4809	2873.6224	3216.9037	3481.8129	3079.5635	2897.3571	2436.2465	1674.9523	1136.5671	794.6062 (83)
Total gains	2201.3773	2683.6281	3311.4275	3986.2280	4251.3391	4444.0111	4001.2009	3821.8356	3400.0278	2710.9903	2254.4638	1983.8665 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
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	21.3280	21.7632	21.7632	22.4505	22.4505	23.1825	23.1825	23.3092	22.8106	21.9876	21.8748	21.4352 (85)
alpha	2.4219	2.4509	2.4509	2.4967	2.4967	2.5455	2.5455	2.5539	2.5207	2.4658	2.4583	2.4290
util living area												
	0.9604	0.9382	0.8939	0.8126	0.7099	0.5554	0.4792	0.4869	0.6582	0.8536	0.9353	0.9667 (86)
MIT	18.8777	19.1332	19.5127	20.0168	20.4064	20.7030	20.7875	20.7874	20.6101	20.0781	19.4677	18.8678 (87)
Th 2	20.0532	20.0704	20.0704	20.0963	20.0963	20.1224	20.1224	20.1268	20.1093	20.0790	20.0747	20.0575 (88)
util rest of house												
	0.9548	0.9298	0.8798	0.7887	0.6715	0.4993	0.4065	0.4122	0.6003	0.8267	0.9245	0.9617 (89)
MIT 2	17.5536	17.8867	18.3614	18.9992	19.4643	19.8154	19.9022	19.9074	19.7159	19.0788	18.3175	17.5448 (90)
Living area fraction												
									FLA = Living area / (4) =			0.3771 (91)
MIT	18.0529	18.3568	18.7955	19.3829	19.8196	20.1502	20.2361	20.2392	20.0531	19.4556	18.7513	18.0437 (92)
Temperature adjustment												
												0.0000
adjusted MIT	18.0529	18.3568	18.7955	19.3829	19.8196	20.1502	20.2361	20.2392	20.0531	19.4556	18.7513	18.0437 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9386	0.9097	0.8560	0.7671	0.6585	0.5012	0.4164	0.4223	0.5963	0.8047	0.9043	0.9471 (94)
Useful gains	2066.1628	2441.1784	2834.6523	3057.7263	2799.6116	2227.3592	1666.1216	1613.9949	2027.5062	2181.5568	2038.6978	1879.0173 (95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000 (96)
Heat loss rate W												
	5810.2869	5695.9456	5380.9383	4656.2437	3657.2270	2526.8173	1804.9739	1752.0956	2478.4368	3609.7618	4621.5755	5631.6955 (97)
Space heating kWh												
	2785.6283	2187.2035	1894.4368	1150.9325	638.0659	0.0000	0.0000	0.0000	0.0000	1062.5846	1859.6720	2791.9926 (98a)
Space heating requirement - total per year (kWh/year)												
												14370.5162
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												
	2785.6283	2187.2035	1894.4368	1150.9325	638.0659	0.0000	0.0000	0.0000	0.0000	1062.5846	1859.6720	2791.9926 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												
												14370.5162
Space heating per m <sup>2</sup>												
										(98c) / (4) =		30.6342 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												
Fraction of space heat from main system(s)												
Efficiency of main space heating system 1 (in %)												
Efficiency of main space heating system 2 (in %)												
Efficiency of secondary/supplementary heating system, %												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	2785.6283	2187.2035	1894.4368	1150.9325	638.0659	0.0000	0.0000	0.0000	0.0000	1062.5846	1859.6720	2791.9926 (98)
Space heating efficiency (main heating system 1)												
	319.7000	319.7000	319.7000	319.7000	319.7000	0.0000	0.0000	0.0000	0.0000	319.7000	319.7000	319.7000 (210)
Space heating fuel (main heating system)												
	871.3257	684.1425	592.5670	360.0039	199.5827	0.0000	0.0000	0.0000	0.0000	332.3693	581.6928	873.3164 (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												
	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329 (64)

Efficiency of water heater (217)m	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	(216)
Fuel for water heating, kWh/month	121.6022	107.4192	113.9345	99.8718	96.5782	86.7827	85.5300	89.0989	90.2561	100.9227	107.6354	120.2464	(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	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa (233a)m	256.4089	231.5951	256.4089	248.1376	256.4089	248.1376	256.4089	256.4089	248.1376	256.4089	248.1376	256.4089	(231)				
Lighting (235c)m	65.0485	52.1843	46.9862	34.4241	26.5902	21.7244	24.2564	31.5294	40.9536	53.7333	60.6917	66.8564	(232)				
Electricity generated by PVs (Appendix M) (negative quantity)	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)	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)	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)	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 wind turbines (Appendix M) (negative quantity)	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 hydro-electric generators (Appendix M) (negative quantity)	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 used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	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)				
Annual totals kWh/year													(235d)				
Space heating fuel - main system 1													4495.0004	(211)			
Space heating fuel - main system 2													0.0000	(213)			
Space heating fuel - secondary													0.0000	(215)			
Efficiency of water heater													224.4000				
Water heating fuel used													1219.8782	(219)			
Space cooling fuel													0.0000	(221)			

Επιμέτρηση Ενέργειας

Electricity for pumps and fans: (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 1.6800) mechanical ventilation fans (SFP = 1.6800)																	3019.0075 (230a)
Total electricity for the above, kWh/year																	3019.0075 (231)
Electricity for lighting (calculated in Appendix L)																	524.9785 (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																	9258.8646 (238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4495.0004	25.1600	1130.9421	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1219.8782	25.1600	306.9214	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	3019.0075	25.1600	759.5823	(249)
Energy for lighting	524.9785	25.1600	132.0846	(250)
Additional standing charges			0.0000	(251)
Total energy cost			2329.5303	(255)

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	4495.0004	0.1547	695.3655	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1219.8782	0.1410	171.9469	(264)
Space and water heating			867.3124	(265)
Pumps, fans and electric keep-hot	3019.0075	0.1387	418.7736	(267)
Energy for lighting	524.9785	0.1443	75.7706	(268)
Total CO2, kg/year			1361.8566	(272)

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	4495.0004	1.5727	7069.3937	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1219.8782	1.5212	1855.6785	(278)
Space and water heating			8925.0722	(279)
Pumps, fans and electric keep-hot	3019.0075	1.5128	4567.1546	(281)
Energy for lighting	524.9785	1.5338	805.2295	(282)
Total Primary energy kWh/year			14297.4563	(286)

SAP 10 EPC IMPROVEMENTS

Leisure Barn-GSHP

Current energy efficiency rating: B 81  
 Current environmental impact rating: A 96

N Solar water heating	SAP increase too small
U Solar photovoltaic panels	Recommended
V2 Wind turbine	Recommended

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 2.2	-£ 324	-172 kg (12.6%)
V2 Wind turbine	+ 4.7	-£ 630	-347 kg (29.2%)
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.4	-£ 70	-35 kg (2.6%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar photovoltaic panels	£324	0.37 kg/m <sup>2</sup>	B 84 A 97
Wind turbine	£630	0.74 kg/m <sup>2</sup>	B 88 A 97
<b>Total Savings</b>	<b>£954</b>	<b>1.11 kg/m<sup>2</sup></b>	
Energy Rating:		B 88	A 97

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South West England):

	Current	Potential	Saving
	£2330	£2330	£0
Electricity	£2330	£2330	£0
Space heating	£1891	£1891	£0
Water heating	£307	£307	£0
Lighting	£132	£132	£0
Generated (PV)	-£0	-£324	£324
Generated (wind)	-£0	-£630	£630
<b>Total cost of fuels</b>	<b>£2330</b>	<b>£1376</b>	<b>£954</b>
<b>Total cost of uses</b>	<b>£2330</b>	<b>£1376</b>	<b>£954</b>
Delivered energy	20 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>	8 kWh/m <sup>2</sup>
Carbon dioxide emissions	1.4 tonnes	0.8 tonnes	0.5 tonnes
CO2 emissions per m <sup>2</sup>	3 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	30 kWh/m <sup>2</sup>	18 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	469.1000 (1b)	x 3.1400 (2b)	= 1472.9740 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	469.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 1472.9740 (5)

### 2. Ventilation rate

	m <sup>3</sup> 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)
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	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2000 (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	0.2550	0.2500	0.2450	0.2200	0.2150	0.1900	0.1900	0.1850	0.2000	0.2150	0.2250	0.2350 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												72.0000 (23c)
Effective ac	0.3950	0.3900	0.3850	0.3600	0.3550	0.3300	0.3300	0.3250	0.3400	0.3550	0.3650	0.3750 (25)

### 3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K
---------	-------	----------	---------	---------	-------	---------	-------

	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K
Window-New (Uw = 1.20)			87.3900	1.1450	100.0649		(27)
Door			4.1000	1.5000	6.1500		(26)
Heatloss Floor 1			339.3000	0.1200	40.7160	110.0000	37323.0000 (28a)
GF-Wall	458.8000	91.4900	367.3100	0.1800	66.1158	0.0000	0.0000 (29a)
Pitch Roof-1	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000 (30)
Pitch Roof-2	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000 (30)
Pitch Roof-3	170.7000		170.7000	0.1300	22.1910	0.0000	0.0000 (30)
Pitch Roof-4	162.3000		162.3000	0.1300	21.0990	0.0000	0.0000 (30)
Flat Roof-1	43.0000		43.0000	0.1300	5.5900	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m2)			1253.3000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	272.2227		(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 37323.0000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 79.5630 (35)  
 List of Thermal Bridges

	Length	Psi-value	Total
E1 Sill	42.2300	0.0000	0.0000
E3 Sill	40.2800	0.0000	0.0000
E4 Jamb	83.0000	0.0000	0.0000
E5 Ground floor (normal)	142.9000	0.0000	0.0000
E16 Corner (normal)	12.5600	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 0.0000 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 272.2227 (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	192.0022	189.5718	187.1413	174.9893	172.5589	160.4069	160.4069	157.9765	165.2677	172.5589	177.4197	182.2805 (38)
Heat transfer coeff	464.2248	461.7944	459.3640	447.2120	444.7816	432.6296	432.6296	430.1991	437.4904	444.7816	449.6424	454.5032 (39)
Average = Sum(39)m / 12 =												446.6044

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9896	0.9844	0.9792	0.9533	0.9482	0.9223	0.9223	0.9171	0.9326	0.9482	0.9585	0.9689 (40)
HLP (average)												0.9520
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.3518 (42)
Hot water usage for mixer showers													0.0000 (42a)
Hot water usage for baths	92.7981	91.4199	89.4792	85.9007	83.2212	80.2501	78.6453	80.5725	82.6708	85.8500	89.5021	92.4844	(42b)
Hot water usage for other uses	48.9554	47.1752	45.3950	43.6148	41.8346	40.0544	40.0544	41.8346	43.6148	45.3950	47.1752	48.9554	(42c)
Average daily hot water use (litres/day)													130.5434 (43)
Daily hot water use	141.7535	138.5951	134.8741	129.5155	125.0558	120.3045	118.6997	122.4070	126.2856	131.2450	136.6773	141.4398	(44)
Energy content	224.5029	197.3576	207.2965	177.3003	168.3492	147.9284	143.5569	151.5655	155.7228	178.0982	194.7219	221.4605	(45)
Energy content (annual)										Total = Sum(45)m =			2167.8607
Distribution loss (46)m = 0.15 x (45)m	33.6754	29.6036	31.0945	26.5950	25.2524	22.1893	21.5335	22.7348	23.3584	26.7147	29.2083	33.2191	(46)
Water storage loss:													250.0000 (47)
Store volume													1.5000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.8100 (55)
Enter (49) or (54) in (55)													
Total storage loss	25.1100	22.6800	25.1100	24.3000	25.1100	24.3000	25.1100	25.1100	24.3000	25.1100	24.3000	25.1100	(56)
If cylinder contains dedicated solar storage													
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	(57)
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	(59)
Total heat required for water heating calculated for each month	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329	(61)
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	(62)
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	(63a)
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	(63b)
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	(63c)
Output from w/h	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329	(63d)
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	(64)
Total Energy used by instantaneous electric shower (s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month	113.3451	100.5744	107.6240	96.4019	94.6740	86.6358	86.4306	89.0934	89.2274	97.9156	102.1946	112.3335	(64b)

#### 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	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	74.3161	66.0069	53.6804	40.6396	30.3785	25.6468	27.7123	36.0215	48.3480	61.3889	71.6499	76.3816 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	871.8642	880.9114	858.1127	809.5770	748.3093	690.7263	652.2574	643.2101	666.0089	714.5446	775.8123	833.3952 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704 (71)
Water heating gains (Table 5)	152.3456	149.6642	144.6559	133.8916	127.2500	120.3275	116.1702	119.7493	123.9270	131.6070	141.9370	150.9859 (72)
Total internal gains	1227.0235	1225.0801	1184.9466	1112.6056	1034.4354	962.1982	921.6374	924.4784	963.7814	1036.0380	1117.8967	1189.2603 (73)

#### 6. Solar gains



(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												5168.3740	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												224.4000	
Water heating fuel used												1219.8782	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 1.6800) mechanical ventilation fans (SFP = 1.6800)												3019.0075	(230a)
Total electricity for the above, kWh/year												3019.0075	(231)
Electricity for lighting (calculated in Appendix L)												524.9785	(232)
Energy saving/generation technologies (Appendices M ,N and Q)												-1163.8850	(233)
Wind generation												-3575.5408	(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												6265.4746	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5168.3740	16.4900	852.2649	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1219.8782	16.4900	201.1579	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	3019.0075	16.4900	497.8343	(249)
Energy for lighting	524.9785	16.4900	86.5690	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1163.8850	16.4900	-191.9246	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-191.9246	(252)
Wind Turbine electricity used in dwelling	-2502.8785	16.4900	-412.7247	
Wind Turbine electricity exported	0.0000	5.5900	0.0000	
Total			-412.7247	(252)
Total energy cost			1033.1768	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7235	(257)
SAP value		88.2723	
SAP rating (Section 12)		88	(258)
SAP band		B	

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	5168.3740	0.1548	800.0399	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1219.8782	0.1410	171.9469	(264)
Space and water heating			971.9868	(265)
Pumps, fans and electric keep-hot	3019.0075	0.1387	418.7736	(267)
Energy for lighting	524.9785	0.1443	75.7706	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1163.8850	0.1331	-154.9372	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-154.9372	(269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801	
Wind Turbine electricity exported	0.0000	0.0000	0.0000	
Total			-347.1801	(269)
Total CO2, kg/year			964.4136	(272)
CO2 emissions per m2			2.0600	(273)
EI value			97.4863	
EI rating			97	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	469.1000 (1b)	x 3.1400 (2b)	= 1472.9740 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	469.1000		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	1472.9740 (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													0 (19)
Shelter factor												(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.2000 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000	(22)
Adj infilt rate	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750	(22a)
	0.3000	0.2800	0.2800	0.2500	0.2500	0.2200	0.2200	0.2150	0.2350	0.2700	0.2750	0.2950	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													72.0000 (23c)
Effective ac	0.4400	0.4200	0.4200	0.3900	0.3900	0.3600	0.3600	0.3550	0.3750	0.4100	0.4150	0.4350	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Window-New (Uw = 1.20)			87.3900	1.1450	100.0649			(27)					
Door			4.1000	1.5000	6.1500			(26)					
Heatloss Floor 1			339.3000	0.1200	40.7160	110.0000	37323.0000	(28a)					
GF-Wall	458.8000	91.4900	367.3100	0.1800	66.1158	0.0000	0.0000	(29a)					
Pitch Roof-1	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000	(30)					
Pitch Roof-2	39.6000		39.6000	0.1300	5.1480	0.0000	0.0000	(30)					
Pitch Roof-3	170.7000		170.7000	0.1300	22.1910	0.0000	0.0000	(30)					
Pitch Roof-4	162.3000		162.3000	0.1300	21.0990	0.0000	0.0000	(30)					
Flat Roof-1	43.0000		43.0000	0.1300	5.5900	0.0000	0.0000	(30)					
Total net area of external elements Aum(A, m2)			1253.3000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	272.2227		(33)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	37323.0000 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								79.5630 (35)					
List of Thermal Bridges				Length	Psi-value	Total							
K1 Element													
E1 Steel lintel with perforated steel base plate				42.2300	0.0000	0.0000							
E3 Sill				40.2800	0.0000	0.0000							
E4 Jamb				83.0000	0.0000	0.0000							
E5 Ground floor (normal)				142.9000	0.0000	0.0000							
E16 Corner (normal)				12.5600	0.0000	0.0000							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000	(36)					
Point Thermal bridges							(36a) =	0.0000					
Total fabric heat loss							(33) + (36) + (36a) =	272.2227 (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	213.8758	204.1542	204.1542	189.5718	189.5718	174.9893	174.9893	172.5589	182.2805	199.2934	201.7238	211.4454	(38)
Heat transfer coeff	486.0985	476.3769	476.3769	461.7944	461.7944	447.2120	447.2120	444.7816	454.5032	471.5161	473.9465	483.6681	(39)
Average = Sum(39)m / 12 =												465.4400	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0362	1.0155	1.0155	0.9844	0.9844	0.9533	0.9533	0.9482	0.9689	1.0052	1.0103	1.0311	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.3518 (42)
Hot water usage for mixer showers													0.0000 (42a)
Hot water usage for baths	92.7981	91.4199	89.4792	85.9007	83.2212	80.2501	78.6453	80.5725	82.6708	85.8500	89.5021	92.4844	(42b)
Hot water usage for other uses	48.9554	47.1752	45.3950	43.6148	41.8346	40.0544	40.0544	41.8346	43.6148	45.3950	47.1752	48.9554	(42c)
Average daily hot water use (litres/day)													130.5434 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	141.7535	138.5951	134.8741	129.5155	125.0558	120.3045	118.6997	122.4070	126.2856	131.2450	136.6773	141.4398	(44)
Energy content (annual)	224.5029	197.3576	207.2965	177.3003	168.3492	147.9284	143.5569	151.5655	155.7228	178.0982	194.7219	221.4605	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m =
Water storage loss:													2167.8607
Store volume													250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.5000 (48)
Temperature factor from Table 2b													0.5400 (49)



Enter (49) or (54) in (55)												0.8100 (55)
Total storage loss	25.1100	22.6800	25.1100	24.3000	25.1100	24.3000	25.1100	25.1100	24.3000	25.1100	24.3000	25.1100 (56)
If cylinder contains dedicated solar storage	25.1100	22.6800	25.1100	24.3000	25.1100	24.3000	25.1100	25.1100	24.3000	25.1100	24.3000	25.1100 (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	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329 (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	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329 (64)
	Total per year (kWh/year) = Sum(64)m =											2737.4067 (64)

Energy Saving Calculation Printout

	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)
Heat gains from water heating, kWh/month	113.3451	100.5744	107.6240	96.4019	94.6740	86.6358	86.4306	89.0934	89.2274	97.9156	102.1946	112.3335 (65)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											0.0000 (64a)

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

Metabolic gains (Table 5), Watts												
(66)m	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056	201.1056 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	74.3161	66.0069	53.6804	40.6396	30.3785	25.6468	27.7123	36.0215	48.3480	61.3889	71.6499	76.3816 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	871.8642	880.9114	858.1127	809.5770	748.3093	690.7263	652.2574	643.2101	666.0089	714.5446	775.8123	833.3952 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623	58.4623 (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)	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704	-134.0704 (71)
Water heating gains (Table 5)	152.3456	149.6642	144.6559	133.8916	127.2500	120.3275	116.1702	119.7493	123.9270	131.6070	141.9370	150.9859 (72)
Total internal gains	1227.0235	1225.0801	1184.9466	1112.6056	1034.4354	962.1982	921.6374	924.4784	963.7814	1036.0380	1117.8967	1189.2603 (73)

6. Solar gains

[Jan]	Area		Solar flux		g		FF		Access		Gains	
	m2		Table 6a		Specific data		Specific data		factor		W	
			W/m2		or Table 6b		or Table 6c		Table 6d			
North	23.4300		14.1962		0.6000		0.8000		0.7700		110.6419 (74)	
East	20.5000		26.5726		0.6000		0.8000		0.7700		181.2020 (76)	
South	27.4900		59.2009		0.6000		0.8000		0.7700		541.3491 (78)	
West	15.9700		26.5726		0.6000		0.8000		0.7700		141.1608 (80)	
Solar gains	974.3539	1458.5480	2126.4809	2873.6224	3216.9037	3481.8129	3079.5635	2897.3571	2436.2465	1674.9523	1136.5671	794.6062 (83)
Total gains	2201.3773	2683.6281	3311.4275	3986.2280	4251.3391	4444.0111	4001.2009	3821.8356	3400.0278	2710.9903	2254.4638	1983.8665 (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)												
tau	21.3280	21.7632	21.7632	22.4505	22.4505	23.1825	23.1825	23.3092	22.8106	21.9876	21.8748	21.4352
alpha	2.4219	2.4509	2.4509	2.4967	2.4967	2.5455	2.5455	2.5539	2.5207	2.4658	2.4583	2.4290
util living area	0.9604	0.9382	0.8939	0.8126	0.7099	0.5554	0.4792	0.4869	0.6582	0.8536	0.9353	0.9667 (86)
MIT	18.8777	19.1332	19.5127	20.0168	20.4064	20.7030	20.7875	20.7874	20.6101	20.0781	19.4677	18.8678 (87)
Th 2	20.0532	20.0704	20.0704	20.0963	20.0963	20.1224	20.1224	20.1268	20.1093	20.0790	20.0747	20.0575 (88)
util rest of house	0.9548	0.9298	0.8798	0.7887	0.6715	0.4993	0.4065	0.4122	0.6003	0.8267	0.9245	0.9617 (89)
MIT 2	17.5536	17.8867	18.3614	18.9992	19.4643	19.8154	19.9022	19.9074	19.7159	19.0788	18.3175	17.5448 (90)
Living area fraction	18.0529	18.3568	18.7955	19.3829	19.8196	20.1502	20.2361	20.2392	20.0531	19.4556	18.7513	18.0437 (91)
Temperature adjustment	18.0529	18.3568	18.7955	19.3829	19.8196	20.1502	20.2361	20.2392	20.0531	19.4556	18.7513	18.0437 (92)
adjusted MIT	18.0529	18.3568	18.7955	19.3829	19.8196	20.1502	20.2361	20.2392	20.0531	19.4556	18.7513	18.0437 (93)

8. Space heating requirement

Utilisation	0.9386	0.9097	0.8560	0.7671	0.6585	0.5012	0.4164	0.4223	0.5963	0.8047	0.9043	0.9471 (94)
Useful gains	2066.1628	2441.1784	2834.6523	3057.7263	2799.6116	2227.3592	1666.1216	1613.9949	2027.5062	2181.5568	2038.6978	1879.0173 (95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000 (96)
Heat loss rate W	5810.2869	5695.9456	5380.9383	4656.2437	3657.2270	2526.8173	1804.9739	1752.0956	2478.4368	3609.7618	4621.5755	5631.6955 (97)
Space heating kWh	2785.6283	2187.2035	1894.4368	1150.9325	638.0659	0.0000	0.0000	0.0000	0.0000	1062.5846	1859.6720	2791.9926 (98a)
Space heating requirement - total per year (kWh/year)												14370.5162
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	2785.6283	2187.2035	1894.4368	1150.9325	638.0659	0.0000	0.0000	0.0000	0.0000	1062.5846	1859.6720	2791.9926 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												14370.5162
Space heating per m2												30.6342 (99)

(98c) / (4) =

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 %)		319.7000	(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	2785.6283	2187.2035	1894.4368	1150.9325	638.0659	0.0000	0.0000	0.0000	0.0000	1062.5846	1859.6720	2791.9926	(98)
Space heating efficiency (main heating system 1)	319.7000	319.7000	319.7000	319.7000	319.7000	0.0000	0.0000	0.0000	0.0000	319.7000	319.7000	319.7000	(210)
Space heating fuel (main heating system)	871.3257	684.1425	592.5670	360.0039	199.5827	0.0000	0.0000	0.0000	0.0000	332.3693	581.6928	873.3164	(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	272.8753	241.0488	255.6689	224.1123	216.7216	194.7404	191.9293	199.9379	202.5348	226.4706	241.5339	269.8329	(64)	
Efficiency of water heater (217)m	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	224.4000	(216)	
Fuel for water heating, kWh/month	121.6022	107.4192	113.9345	99.8718	96.5782	86.7827	85.5300	89.0989	90.2561	100.9227	107.6354	120.2464	(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	256.4089	231.5951	256.4089	248.1376	256.4089	248.1376	256.4089	256.4089	248.1376	256.4089	248.1376	256.4089	(231)	
Lighting	65.0485	52.1843	46.9862	34.4241	26.5902	21.7244	24.2564	31.5294	40.9536	53.7333	60.6917	66.8564	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-55.3045	-73.9685	-116.7201	-144.1648	-157.7969	-151.9944	-142.2619	-135.3796	-113.6725	-89.3462	-60.9309	-45.3369	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	(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													4495.0004	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													224.4000	
Water heating fuel used													1219.8782	(219)
Space cooling fuel													0.0000	(221)

Electricity for pumps and fans: (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 1.6800) mechanical ventilation fans (SFP = 1.6800)													3019.0075	(230a)
Total electricity for the above, kWh/year													3019.0075	(231)
Electricity for lighting (calculated in Appendix L)													524.9785	(232)

Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-1286.8773	(233)
Wind generation													-3575.5408	(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													5469.1087	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4495.0004	25.1600	1130.9421	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1219.8782	25.1600	306.9214	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	3019.0075	25.1600	759.5823	(249)
Energy for lighting	524.9785	25.1600	132.0846	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1286.8773	25.1600	-323.7783	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-323.7783	(252)
Wind Turbine electricity used in dwelling	-2502.8785	25.1600	-629.7242	
Wind Turbine electricity exported	0.0000	5.8100	0.0000	
Total			-629.7242	(252)
Total energy cost			1376.0278	(255)

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	4495.0004	0.1547	695.3655	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1219.8782	0.1410	171.9469	(264)
Space and water heating			867.3124	(265)
Pumps, fans and electric keep-hot	3019.0075	0.1387	418.7736	(267)
Energy for lighting	524.9785	0.1443	75.7706	(268)

Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1286.8773	0.1336	-171.9551
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-171.9551 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-347.1801 (269)
Total CO2, kg/year			842.7214 (272)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
4495.0004	4495.0004	1.5727	7069.3937 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1219.8782	1.5212	1855.6785 (278)
Space and water heating			8925.0722 (279)
Pumps, fans and electric keep-hot	3019.0075	1.5128	4567.1546 (281)
Energy for lighting	524.9785	1.5338	805.2295 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1286.8773	1.4938	-1922.3065
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1922.3065 (283)
Wind Turbine electricity used in dwelling	-2502.8785	1.5128	-3786.3546
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-3786.3546 (283)
Total Primary energy kWh/year			8588.7952 (286)

Property Reference	2324 Cart Shed		Issued on Date	22/01/2024	
Assessment Reference	Cart Shed -ASHP	Prop Type Ref			
Property					
SAP Rating	75 C	DER	4.93	TER	10.70
Environmental	95 A	% DER < TER	53.93		
CO <sub>2</sub> Emissions (t/year)	0.79	DFEE	59.94	TFEE	65.02
Compliance Check	See BREL	% DFEE < TFEE	7.81		
% DPER < TPER	14.27	DPER	51.11	TPER	59.62
Client	Mr. Abdul Mohammed		Assessor ID	K333-0001	

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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	182.1000 (1b)	x 3.3100 (2b)	= 602.7510 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	182.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 602.7510 (5)

2. Ventilation rate

		m <sup>3</sup> 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	5 * 10 =	50.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	50.0000 / (5) =	0.0830 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		3.0000 (17)
Infiltration rate		0.2330 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2330 (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	0.2970	0.2912	0.2854	0.2562	0.2504	0.2213	0.2213	0.2155	0.2330	0.2504	0.2621	0.2737 (22b)
Effective ac	0.5441	0.5424	0.5407	0.5328	0.5314	0.5245	0.5245	0.5232	0.5271	0.5314	0.5343	0.5375 (25)

3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window-New (Uw = 1.20)			38.8200	1.1450	44.4504		(27)
Half Glazing Door			12.8700	1.5000	19.3050		(26a)
Heatloss Floor 1			182.1000	0.1200	21.8520	110.0000	20031.0000 (28a)
GF-Wall	458.8000	51.6900	407.1100	0.1800	73.2798	0.0000	0.0000 (29a)
Pitch Roof-1	80.8000		80.8000	0.1300	10.5040	0.0000	0.0000 (30)
Pitch Roof-2	80.8000		80.8000	0.1300	10.5040	0.0000	0.0000 (30)
Pitch Roof-3	28.8000		28.8000	0.1300	3.7440	0.0000	0.0000 (30)
Pitch Roof-4	28.8000		28.8000	0.1300	3.7440	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			860.1000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	187.3832	(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 20031.0000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 110.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	25.1100	0.0000	0.0000
E3 Sill	19.2600	0.0000	0.0000
E4 Jamb	83.0000	0.0000	0.0000
E5 Ground floor (normal)	101.8500	0.0000	0.0000
E16 Corner (normal)	13.2400	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
 Point Thermal bridges (36a) = 0.0000 (36)  
 Total fabric heat loss (33) + (36) + (36a) = 187.3832 (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
(39)m	108.2275	107.8868	107.5529	105.9844	105.6909	104.3248	104.3248	104.0718	104.8510	105.6909	106.2846	106.9053 (38)
Heat transfer coeff	295.6107	295.2700	294.9361	293.3676	293.0741	291.7080	291.7080	291.4550	292.2342	293.0741	293.6678	294.2884 (39)
Average = Sum(39)m / 12 =												293.3662
HLP	1.6233	1.6215	1.6196	1.6110	1.6094	1.6019	1.6019	1.6005	1.6048	1.6094	1.6127	Dec 1.6161 (40)
HLP (average)												1.6110
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												2.9786 (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	85.5535	84.2830	82.4937	79.1946	76.7243	73.9852	72.5056	74.2823	76.2169	79.1479	82.5149	85.2643 (42b)
Hot water usage for other uses	45.1335	43.4923	41.8511	40.2099	38.5687	36.9274	36.9274	38.5687	40.2099	41.8511	43.4923	45.1335 (42c)
Average daily hot water use (litres/day)												120.3521 (43)
Daily hot water use	130.6871	127.7753	124.3448	119.4045	115.2930	110.9126	109.4330	112.8510	116.4267	120.9990	126.0072	130.3978 (44)
Energy content (annual)	206.9764	181.9503	191.1133	163.4588	155.2065	136.3800	132.3498	139.7331	143.5658	164.1945	179.5204	204.1715 (45)
Distribution loss (46)m = 0.15 x (45)m	31.0465	27.2925	28.6670	24.5188	23.2810	20.4570	19.8525	20.9600	21.5349	24.6292	26.9281	30.6257 (46)
Water storage loss:												
Store volume												400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9288 (55)
Total storage loss	28.7928	26.0064	28.7928	27.8640	28.7928	27.8640	28.7928	28.7928	27.8640	28.7928	27.8640	28.7928 (56)
If cylinder contains dedicated solar storage	28.7928	26.0064	28.7928	27.8640	28.7928	27.8640	28.7928	28.7928	27.8640	28.7928	27.8640	28.7928 (57)
Primary loss	37.2980	33.6885	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	36.0948	37.2980	36.0948	37.2980 (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	273.0671	241.6452	257.2041	227.4176	221.2973	200.3388	198.4405	205.8238	207.5246	230.2852	243.4792	270.2623 (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	273.0671	241.6452	257.2041	227.4176	221.2973	200.3388	198.4405	205.8238	207.5246	230.2852	243.4792	270.2623 (64)
Total per year (kWh/year)												2776.7856 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	121.6923	108.2544	116.4178	105.5171	104.4788	96.5134	96.8789	99.3339	98.9027	107.4673	110.8576	120.7596 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.7166	197.8648	178.7166	184.6738	178.7166	184.6738	178.7166	178.7166	184.6738	178.7166	184.6738	178.7166 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	353.6982	357.3685	348.1195	328.4295	303.5744	280.2141	264.6080	260.9377	270.1867	289.8767	314.7318	338.0921 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928 (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)	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428 (71)
Water heating gains (Table 5)	163.5649	161.0928	156.4755	146.5515	140.4285	134.0464	130.2136	133.5133	137.3648	144.4453	153.9688	162.3113 (72)
Total internal gains	766.6581	787.0046	753.9901	730.3333	693.3979	666.6128	641.2167	640.8461	659.9039	683.7171	724.0530	749.7985 (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	11.5500	10.6334	0.6300	0.7000	0.7700	37.5341 (74)						
East	1.5600	19.6403	0.6300	0.7000	0.7700	9.3636 (76)						
South	23.7900	46.7521	0.6300	0.7000	0.7700	339.9124 (78)						
West	1.9200	19.6403	0.6300	0.7000	0.7700	11.5245 (80)						
Solar gains	398.3346	669.2800	898.3021	1095.3861	1219.1856	1209.2020	1166.1206	1072.4596	965.5738	734.3116	475.2602	342.1832 (83)
Total gains	1164.9927	1456.2846	1652.2922	1825.7194	1912.5836	1875.8147	1807.3373	1713.3057	1625.4777	1418.0286	1199.3132	1091.9817 (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	18.8226	18.8443	18.8657	18.9665	18.9855	19.0744	19.0744	19.0910	19.0401	18.9855	18.9471	18.9072	
alpha	2.2548	2.2563	2.2577	2.2644	2.2657	2.2716	2.2716	2.2727	2.2693	2.2657	2.2631	2.2605	
util living area	0.9703	0.9509	0.9249	0.8784	0.8050	0.6927	0.5697	0.6059	0.7649	0.8971	0.9550	0.9742	(86)
MIT	18.2533	18.5522	18.9774	19.5255	20.0485	20.4740	20.6906	20.6569	20.3324	19.6422	18.8444	18.1974	(87)
Th 2	19.5963	19.5976	19.5990	19.6053	19.6064	19.6119	19.6119	19.6130	19.6098	19.6064	19.6041	19.6016	(88)
util rest of house	0.9647	0.9418	0.9103	0.8523	0.7572	0.6043	0.4325	0.4737	0.6908	0.8696	0.9451	0.9693	(89)
MIT 2	16.4333	16.8113	17.3476	18.0333	18.6662	19.1490	19.3540	19.3302	19.0064	18.1913	17.1906	16.3654	(90)
Living area fraction										FLA = Living area / (4) =			0.1636 (91)
MIT	16.7311	17.0962	17.6143	18.2775	18.8924	19.3658	19.5727	19.5473	19.2234	18.4288	17.4613	16.6652	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.7311	17.0962	17.6143	18.2775	18.8924	19.3658	19.5727	19.5473	19.2234	18.4288	17.4613	16.6652	(93)



8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9475	0.9185	0.8817	0.8198	0.7268	0.5856	0.4281	0.4663	0.6651	0.8379	0.9226	0.9537	(94)
Useful gains	1103.8671	1337.5894	1456.8086	1496.7858	1390.0054	1098.5325	773.6338	798.9608	1081.1842	1188.2343	1106.5116	1041.4463	(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	3674.7679	3601.1630	3278.0216	2751.0547	2107.9028	1390.2220	867.1631	917.3057	1497.2417	2294.4045	3042.7702	3668.3643	(97)
Space heating kWh	1912.7502	1521.1215	1354.9825	903.0736	534.1157	0.0000	0.0000	0.0000	0.0000	822.9906	1394.1062	1954.4270	(98a)
Space heating requirement - total per year (kWh/year)												10397.5673	
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	1912.7502	1521.1215	1354.9825	903.0736	534.1157	0.0000	0.0000	0.0000	0.0000	822.9906	1394.1062	1954.4270	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10397.5673	
Space heating per m2												57.0981	(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 %)													249.9000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement	1912.7502	1521.1215	1354.9825	903.0736	534.1157	0.0000	0.0000	0.0000	0.0000	822.9906	1394.1062	1954.4270	(98)	
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)	
Space heating fuel (main heating system)	765.4063	608.6921	542.2099	361.3740	213.7318	0.0000	0.0000	0.0000	0.0000	329.3280	557.8656	782.0836	(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	273.0671	241.6452	257.2041	227.4176	221.2973	200.3388	198.4405	205.8238	207.5246	230.2852	243.4792	270.2623	(64)	
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)	
Fuel for water heating, kWh/month	155.9493	138.0041	146.8898	129.8787	126.3834	114.4139	113.3298	117.5465	118.5178	131.5164	139.0515	154.3474	(219)	
Space cooling fuel requirement														
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)	
Lighting	29.1462	23.3822	21.0531	15.4244	11.9142	9.7340	10.8686	14.1274	18.3501	24.0763	27.1941	29.9563	(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													4160.6912	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.1000	
Water heating fuel used													1585.8285	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
Total electricity for the above, kWh/year													0.0000	(231)
Electricity for lighting (calculated in Appendix L)													235.2269	(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

5981.7466 (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	4160.6912	0.1542	641.5051 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1585.8285	0.1407	223.2051 (264)
Space and water heating			864.7101 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	235.2269	0.1443	33.9505 (268)
Total CO2, kg/year			898.6607 (272)
Dwelling CO2 Emission Rate (DER)			4.9300 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	4160.6912	1.5708	6535.6598 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1585.8285	1.5204	2411.1479 (278)
Space and water heating			8946.8077 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	235.2269	1.5338	360.7989 (282)
Total Primary energy kWh/year			9307.6066 (286)
Dwelling Primary energy Rate (DPER)			51.1100 (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	182.1000 (1b)	x 3.3100 (2b)	= 602.7510 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	182.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	602.7510 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0664 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3164 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3164 (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	0.4034	0.3955	0.3875	0.3480	0.3401	0.3005	0.3005	0.2926	0.3164	0.3401	0.3559	0.3717 (22b)
Effective ac	0.5814	0.5782	0.5751	0.5606	0.5578	0.5452	0.5452	0.5428	0.5500	0.5578	0.5633	0.5691 (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 Semi-glazed door			12.8700	1.0000	12.8700		(26a)
TER Opening Type (Uw = 1.20)			32.6700	1.1450	37.4084		(27)
Heatloss Floor 1			182.1000	0.1300	23.6730		(28a)
GF-Wall	458.8000	45.5400	413.2600	0.1800	74.3868		(29a)
Pitch Roof-1	80.8000		80.8000	0.1100	8.8880		(30)
Pitch Roof-2	80.8000		80.8000	0.1100	8.8880		(30)
Pitch Roof-3	28.8000		28.8000	0.1100	3.1680		(30)
Pitch Roof-4	28.8000		28.8000	0.1100	3.1680		(30)
Total net area of external elements Aum(A, m2)			860.1000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	172.4502	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 110.0000 (35)

List of Thermal Bridges table with columns: K1 Element, Length, Psi-value, Total. Includes items like E1 Steel lintel with perforated steel base plate, E3 Sill, E4 Jamb, E5 Ground floor (normal), E16 Corner (normal).

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.8561 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 196.3063 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) table with columns: (38)m, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec. Includes average calculation: Average = Sum(39)m / 12 = 307.8018 (39)

HLP (average) table with columns: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec. Includes Days in month row.

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9786 (42)
Hot water usage for mixer showers 0.0000 (42a)
Hot water usage for baths 85.5535 (42b)
Hot water usage for other uses 45.1335 (42c)
Average daily hot water use (litres/day) 120.3521 (43)

Daily hot water use table with columns: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec. Includes Energy content (annual) Total = Sum(45)m = 1998.6202

Distribution loss (46)m = 0.15 x (45)m 31.0465
Water storage loss: Store volume 400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): Temperature factor from Table 2b 0.5400 (48)
Enter (49) or (54) in (55) 1.3626 (55)

Total storage loss 42.2417 (56)
If cylinder contains dedicated solar storage 42.2417 (57)
Primary loss 23.2624 (59)
Combi loss 0.0000 (61)

Total heat required for water heating calculated for each month 272.4805 (62)
MWHRS 0.0000 (63a)
PV diverter -0.0000 (63b)
Solar input 0.0000 (63c)
FGHRS 0.0000 (63d)
Output from w/h 272.4805 (64)
Total per year (kWh/year) = Sum(64)m = 2769.8784 (64)
Electric shower(s) 0.0000 (64a)

Heat gains from water heating, kWh/month 121.2229 (65)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

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

Metabolic gains (Table 5), Watts 148.9285 (66)m
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 182.3065 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 353.6982 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 37.8928 (69)
Pumps, fans 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5) -119.1428 (71)
Water heating gains (Table 5) 162.9341 (72)
Total internal gains 769.6172 (73)

6. Solar gains

[Jan] table with columns: Area m2, Solar flux Table 6a W/m2, Specific data or Table 6b g, Specific data or Table 6c FF, Access factor Table 6d, Gains W. Includes North, East, South, West rows.









654.9477 676.3845 645.8544 628.1479 594.7149 574.6218 551.7379 549.6800 566.6992 583.3883 618.0416 638.8966 (73)

6. Solar gains

[Jan]			Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W		
North			11.5500	10.6334	0.6300		0.7000		0.7700	37.5341 (74)		
East			1.5600	19.6403	0.6300		0.7000		0.7700	9.3636 (76)		
South			23.7900	46.7521	0.6300		0.7000		0.7700	339.9124 (78)		
West			1.9200	19.6403	0.6300		0.7000		0.7700	11.5245 (80)		
Solar gains	398.3346	669.2800	898.3021	1095.3861	1219.1856	1209.2020	1166.1206	1072.4596	965.5738	734.3116	475.2602	342.1832 (83)
Total gains	1053.2823	1345.6645	1544.1565	1723.5340	1813.9005	1783.8237	1717.8586	1622.1396	1532.2730	1317.6999	1093.3019	981.0798 (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	18.8997	18.9186	18.9371	19.0247	19.0412	19.1183	19.1183	19.1326	19.0885	19.0412	19.0079	18.9732
alpha	2.2600	2.2612	2.2625	2.2683	2.2694	2.2746	2.2746	2.2755	2.2726	2.2694	2.2672	2.2649
util living area	0.9757	0.9577	0.9334	0.8891	0.8188	0.7095	0.5880	0.6255	0.7822	0.9091	0.9623	0.9792 (86)
MIT	17.4358	17.8399	18.4139	19.1555	19.8667	20.4499	20.7508	20.7022	20.2518	19.3068	18.2279	17.3585 (87)
Th 2	19.6011	19.6023	19.6034	19.6089	19.6099	19.6146	19.6146	19.6155	19.6128	19.6099	19.6078	19.6057 (88)
util rest of house	0.9710	0.9497	0.9201	0.8648	0.7731	0.6225	0.4498	0.4930	0.7108	0.8841	0.9538	0.9752 (89)
MIT 2	16.4099	16.8092	17.3750	18.0999	18.7739	19.2931	19.5182	19.4907	19.1360	18.2600	17.2016	16.3360 (90)
Living area fraction	fLA = Living area / (4) = 0.1636 (91)											
MIT	16.5778	16.9779	17.5450	18.2726	18.9527	19.4824	19.7199	19.6890	19.3186	18.4313	17.3696	16.5034 (92)
Temperature adjustment	0.0000											
adjusted MIT	16.5778	16.9779	17.5450	18.2726	18.9527	19.4824	19.7199	19.6890	19.3186	18.4313	17.3696	16.5034 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9555	0.9278	0.8928	0.8340	0.7461	0.6126	0.4619	0.5013	0.6919	0.8549	0.9333	0.9613 (94)
Useful gains	1006.4492	1248.4770	1378.6941	1437.3955	1353.4218	1092.8309	793.4110	813.1015	1060.1886	1126.5307	1020.4016	943.1353 (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	3614.6506	3552.2510	3245.2914	2741.2144	2119.3638	1420.9629	908.0047	956.5077	1521.1927	2288.4432	3006.2041	3608.1472 (97)
Space heating kWh	1940.5018	1548.1362	1388.7484	938.7496	569.8609	0.0000	0.0000	0.0000	0.0000	864.4629	1429.7778	1982.7689 (98a)
Space heating requirement - total per year (kWh/year)	10663.0065											
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	1940.5018	1548.1362	1388.7484	938.7496	569.8609	0.0000	0.0000	0.0000	0.0000	864.4629	1429.7778	1982.7689 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	10663.0065											
Space heating per m <sup>2</sup>	(98c) / (4) = 58.5558 (99)											

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2735.7654	2153.6876	2210.2368	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5816	0.6559	0.6255	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1591.1924	1412.6376	1382.4962	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2004.6967	1930.9880	1822.7145	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	297.7231	385.6527	327.5224	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) = 1.0000 (105)											
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	74.4308	96.4132	81.8806	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement	252.7246 (107)											
Energy for space heating	58.5558 (99)											
Energy for space cooling	1.3878 (108)											
Total	59.9436 (109)											
Fabric Energy Efficiency (DFEE)	59.9 (109)											

1. Overall dwelling characteristics

Area (m<sup>2</sup>) Storey height (m) Volume (m<sup>3</sup>)

Ground floor  
 Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 182.1000 182.1000 (1b) x 3.3100 (2b) = 602.7510 (1b) - (3b)  
 Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 602.7510 (4)  
 (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 blocked chimneys 0 \* 35 = 0.0000 (6e)  
 Number of intermittent extract fans 0 \* 20 = 0.0000 (6f)  
 Number of passive vents 4 \* 10 = 40.0000 (7a)  
 Number of flueless gas fires 0 \* 10 = 0.0000 (7b)  
 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) = 0.0664 (8)  
 Pressure test Yes  
 Pressure Test Method Blower Door  
 Measured/design AP50 5.0000 (17)  
 Infiltration rate 0.3164 (18)  
 Number of sides sheltered 0 (19)  
 Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3164 (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 infiltr rate	0.4034	0.3955	0.3875	0.3480	0.3401	0.3005	0.3005	0.2926	0.3164	0.3401	0.3559	0.3717 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5814	0.5782	0.5751	0.5606	0.5578	0.5452	0.5452	0.5428	0.5500	0.5578	0.5633	0.5691 (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 Semi-glazed door			12.8700	1.0000	12.8700		(26a)
TER Opening Type (Uw = 1.20)			32.6700	1.1450	37.4084		(27)
Heatloss Floor 1			182.1000	0.1300	23.6730		(28a)
GF-Wall	458.8000	45.5400	413.2600	0.1800	74.3868		(29a)
Pitch Roof-1	80.8000		80.8000	0.1100	8.8880		(30)
Pitch Roof-2	80.8000		80.8000	0.1100	8.8880		(30)
Pitch Roof-3	28.8000		28.8000	0.1100	3.1680		(30)
Pitch Roof-4	28.8000		28.8000	0.1100	3.1680		(30)
Total net area of external elements Aum(A, m2)			860.1000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 172.4502		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 110.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	25.1100	0.0500	1.2555
E3 Sill	19.2600	0.0500	0.9630
E4 Jamb	83.0000	0.0500	4.1500
E5 Ground floor (normal)	101.8500	0.1600	16.2960
E16 Corner (normal)	13.2400	0.0900	1.1916

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.8561 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 196.3063 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	115.6352	115.0068	114.3909	111.4981	110.9568	108.4373	108.4373	107.9707	109.4078	110.9568	112.0518	113.1965 (38)
Average = Sum(39)m / 12 =	311.9415	311.3131	310.6972	307.8044	307.2631	304.7436	304.7436	304.2770	305.7141	307.2631	308.3581	309.5028 (39)
												307.8018

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.7130	1.7096	1.7062	1.6903	1.6873	1.6735	1.6735	1.6709	1.6788	1.6873	1.6933	1.6996 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9786 (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	32.0147	31.5393	30.8697	29.6352	28.7108	27.6858	27.1321	27.7970	28.5209	29.6177	30.8777	31.9065 (42b)
Hot water usage for other uses	45.1335	43.4923	41.8511	40.2099	38.5687	36.9274	36.9274	38.5687	40.2099	41.8511	43.4923	45.1335 (42c)
Average daily hot water use (litres/day)												70.7132 (43)
Daily hot water use	77.1483	75.0316	72.7208	69.8451	67.2794	64.6132	64.0595	66.3656	68.7308	71.4688	74.3700	77.0400 (44)
Energy conte	122.1840	106.8440	111.7692	95.6144	90.5710	79.4495	77.4744	82.1745	84.7519	96.9825	105.9536	120.6261 (45)
Energy content (annual)												Total = Sum(45)m = 1174.3951
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
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	0.0000	0.0000	(59)
Total heat required for water heating calculated for each month	103.8564	90.8174	95.0038	81.2722	76.9854	67.5320	65.8533	69.8483	72.0391	82.4351	90.0606	102.5322	102.5322	102.5322	(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	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	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	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	0.0000	0.0000	(63d)
Output from w/h	103.8564	90.8174	95.0038	81.2722	76.9854	67.5320	65.8533	69.8483	72.0391	82.4351	90.0606	102.5322	102.5322	102.5322	(64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =												998.2358	(64)	
Electric shower(s)	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												998	(64)	
	59.3903	52.9173	57.7836	55.1422	56.1769	53.5874	55.3736	56.1769	55.1422	57.7836	56.6971	59.3903	59.3903	59.3903	(64a)
													675.5616	(64a)	
													40.4806	(65)	

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	148.9285	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	182.3065	201.8393	182.3065	188.3833	182.3065	188.3833	182.3065	182.3065	188.3833	182.3065	188.3833	182.3065	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	353.6982	357.3685	348.1195	328.4295	303.5744	280.2141	264.6080	260.9377	270.1867	289.8767	314.7318	338.0921	(68)
Pumps, fans	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	37.8928	(69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	(71)
Total internal gains	54.8544	53.4727	51.3399	47.3661	44.7454	42.0553	40.7348	42.3472	44.1602	47.1165	50.9575	54.4094	(72)
	658.5376	680.3590	649.4443	631.8575	598.3048	578.3313	555.3278	553.2699	570.4088	586.9782	621.7512	642.4865	(73)

6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains						
		m <sup>2</sup>	Table 6a	Specific data	Specific data	Factor	W						
			W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d							
North		9.7200	10.6334	0.6300	0.7000	0.7700	31.5871 (74)						
East		1.3100	19.6403	0.6300	0.7000	0.7700	7.8630 (76)						
South		20.0200	46.7521	0.6300	0.7000	0.7700	286.0465 (78)						
West		1.6200	19.6403	0.6300	0.7000	0.7700	9.7238 (80)						
Solar gains	335.2204	563.2386	755.9802	921.8475	1026.0398	1017.6400	981.3827	902.5556	812.5967	617.9682	399.9581	287.9656	(83)
Total gains	993.7580	1243.5976	1405.4245	1553.7049	1624.3446	1595.9713	1536.7106	1455.8255	1383.0055	1204.9464	1021.7093	930.4521	(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	17.8372	17.8732	17.9086	18.0770	18.1088	18.2585	18.2585	18.2865	18.2006	18.1088	18.0445	17.9778	17.9778	
alpha	2.1891	2.1915	2.1939	2.2051	2.2073	2.2172	2.2172	2.2191	2.2134	2.2073	2.2030	2.1985	2.1985	
util living area	0.9784	0.9641	0.9453	0.9097	0.8517	0.7550	0.6411	0.6757	0.8178	0.9243	0.9673	0.9812	(86)	
MIT	17.2199	17.5949	18.1607	18.9253	19.6756	20.3276	20.6791	20.6245	20.1188	19.1295	18.0418	17.1615	(87)	
Th 2	19.5315	19.5340	19.5364	19.5478	19.5499	19.5599	19.5599	19.5617	19.5560	19.5499	19.5456	19.5411	(88)	
util rest of house	0.9741	0.9571	0.9337	0.8884	0.8101	0.6702	0.4962	0.5395	0.7505	0.9022	0.9597	0.9775	(89)	
MIT 2	16.1563	16.5286	17.0890	17.8446	18.5651	19.1614	19.4341	19.4022	18.9886	18.0558	16.9827	16.1039	(90)	
Living area fraction	16.3303	16.7031	17.2644	18.0214	18.7468	19.3522	19.6379	19.6023	19.1736	18.2315	17.1560	16.2770	(91)	
MIT	16.3303	16.7031	17.2644	18.0214	18.7468	19.3522	19.6379	19.6023	19.1736	18.2315	17.1560	16.2770	(92)	
Temperature adjustment	16.3303	16.7031	17.2644	18.0214	18.7468	19.3522	19.6379	19.6023	19.1736	18.2315	17.1560	16.2770	(93)	
adjusted MIT	16.3303	16.7031	17.2644	18.0214	18.7468	19.3522	19.6379	19.6023	19.1736	18.2315	17.1560	16.2770	(93)	

8. Space heating requirement

Utilisation	0.9593	0.9364	0.9077	0.8575	0.7800	0.6551	0.5056	0.5441	0.7273	0.8732	0.9402	0.9643	(94)
Useful gains	953.3276	1164.5309	1275.6616	1332.2539	1267.0646	1045.5161	776.9740	792.1564	1005.8420	1052.1461	960.5948	897.2059	(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	3752.7607	3674.4637	3344.4675	2807.6222	2165.2264	1448.2138	925.7657	974.3769	1551.0562	2344.8738	3100.8482	3737.8551	(97)
Space heating kWh	2082.7782	1686.6749	1539.1916	1062.2651	668.2324	0.0000	0.0000	0.0000	0.0000	961.7893	1540.9825	2113.4429	(98a)
Space heating requirement - total per year (kWh/year)	11655.3570												
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	2082.7782	1686.6749	1539.1916	1062.2651	668.2324	0.0000	0.0000	0.0000	0.0000	961.7893	1540.9825	2113.4429	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)	11655.3570												
Space heating per m <sup>2</sup>	(98c) / (4) = 64.0053 (99)												

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	2864.5896	2255.1024	2312.5051	0.0000	0.0000	0.0000	0.0000	(100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.5171	0.5911	0.5619	0.0000	0.0000	0.0000	0.0000	(101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1481.1918	1332.9232	1299.4938	0.0000	0.0000	0.0000	0.0000	(102)
Space cooling kWh													(103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	215.9391	284.5627	241.8542	0.0000	0.0000	0.0000	0.0000	(104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	53.9848	71.1407	60.4635	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling requirement													(107)
Energy for space heating													(108)
													(109)
Fabric Energy Efficiency (TFEE)													(109)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	182.1000 (1b)	x 3.3100 (2b)	= 602.7510 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	182.1000		602.7510 (4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	602.7510 (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	5 * 10 =	50.0000 (7a)	
Number of passive vents	0 * 10 =	0.0000 (7b)	
Number of flueless gas fires	0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.0830 (8)	Air changes per hour
Pressure test	Yes		
Pressure Test Method	Blower Door		
Measured/design AP50	3.0000		(17)
Infiltration rate	0.2330		(18)
Number of sides sheltered	0		(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2330	(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													
Effective ac	0.2970	0.2912	0.2854	0.2562	0.2504	0.2213	0.2213	0.2155	0.2330	0.2504	0.2621	0.2737	(22b)
	0.5441	0.5424	0.5407	0.5328	0.5314	0.5245	0.5245	0.5232	0.5271	0.5314	0.5343	0.5375	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window-New (Uw = 1.20)			38.8200	1.1450	44.4504			(27)
Half Glazing Door			12.8700	1.5000	19.3050			(26a)
Heatloss Floor 1			182.1000	0.1200	21.8520	110.0000	20031.0000	(28a)
GF-Wall	458.8000	51.6900	407.1100	0.1800	73.2798	0.0000	0.0000	(29a)
Pitch Roof-1	80.8000		80.8000	0.1300	10.5040	0.0000	0.0000	(30)
Pitch Roof-2	80.8000		80.8000	0.1300	10.5040	0.0000	0.0000	(30)
Pitch Roof-3	28.8000		28.8000	0.1300	3.7440	0.0000	0.0000	(30)
Pitch Roof-4	28.8000		28.8000	0.1300	3.7440	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			860.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	187.3832			(33)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	20031.0000			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							110.0000	(35)
List of Thermal Bridges								
K1 Element				Length	Psi-value	Total		
E1 Steel lintel with perforated steel base plate				25.1100	0.0000	0.0000		
E3 Sill				19.2600	0.0000	0.0000		
E4 Jamb				83.0000	0.0000	0.0000		
E5 Ground floor (normal)				101.8500	0.0000	0.0000		
E16 Corner (normal)				13.2400	0.0000	0.0000		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000	(36)
Point Thermal bridges							(36a) =	0.0000
Total fabric heat loss							(33) + (36) + (36a) =	187.3832 (37)





	0.9663	0.9473	0.9196	0.8737	0.8004	0.6904	0.5673	0.6029	0.7616	0.8923	0.9514	0.9708 (86)
MIT	18.3009	18.5847	19.0122	19.5455	20.0602	20.4770	20.6922	20.6591	20.3380	19.6616	18.8742	18.2415 (87)
Th 2	19.5963	19.5976	19.5990	19.6053	19.6064	19.6119	19.6119	19.6130	19.6098	19.6064	19.6041	19.6016 (88)
util rest of house												
	0.9601	0.9376	0.9041	0.8469	0.7520	0.6019	0.4303	0.4708	0.6870	0.8638	0.9407	0.9653 (89)
MIT 2	16.4932	16.8518	17.3902	18.0568	18.6787	19.1516	19.3549	19.3316	19.0118	18.2141	17.2277	16.4210 (90)
Living area fraction									fIA = Living area / (4) = 0.1636 (91)			
MIT	16.7890	17.1353	17.6556	18.3004	18.9048	19.3685	19.5737	19.5489	19.2288	18.4510	17.4972	16.7189 (92)
Temperature adjustment												0.0000
adjusted MIT	16.7890	17.1353	17.6556	18.3004	18.9048	19.3685	19.5737	19.5489	19.2288	18.4510	17.4972	16.7189 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9415	0.9135	0.8749	0.8143	0.7218	0.5834	0.4260	0.4637	0.6616	0.8319	0.9173	0.9484 (94)
Useful gains	1168.8439	1380.9515	1501.9813	1521.7762	1403.7147	1101.5939	774.8619	800.7642	1087.2332	1212.3562	1146.1870	1101.8057 (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	3691.8797	3612.7293	3290.1861	2757.7818	2111.5293	1390.9954	867.4647	917.7513	1498.8170	2300.9105	3053.3107	3684.1596 (97)
Space heating kWh	1877.1387	1499.7547	1330.4243	889.9240	526.6141	0.0000	0.0000	0.0000	0.0000	809.8844	1373.1291	1921.2713 (98a)
Space heating requirement - total per year (kWh/year)												10228.1406
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	1877.1387	1499.7547	1330.4243	889.9240	526.6141	0.0000	0.0000	0.0000	0.0000	809.8844	1373.1291	1921.2713 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												10228.1406
Space heating per m2												(98c) / (4) = 56.1677 (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 %)												249.9000 (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	1877.1387	1499.7547	1330.4243	889.9240	526.6141	0.0000	0.0000	0.0000	0.0000	809.8844	1373.1291	1921.2713 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system)	751.1559	600.1419	532.3827	356.1121	210.7299	0.0000	0.0000	0.0000	0.0000	324.0834	549.4714	768.8161 (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	273.0671	241.6452	257.2041	227.4176	221.2973	200.3388	198.4405	205.8238	207.5246	230.2852	243.4792	270.2623 (64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	155.9493	138.0041	146.8898	129.8787	126.3834	114.4139	113.3298	117.5465	118.5178	131.5164	139.0515	154.3474 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	29.1462	23.3822	21.0531	15.4244	11.9142	9.7340	10.8686	14.1274	18.3501	24.0763	27.1941	29.9563 (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												4092.8934 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												175.1000
Water heating fuel used												1585.8285 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												235.2269 (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												5913.9488 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4092.8934	16.4900	674.9181	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1585.8285	16.4900	261.5031	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	235.2269	16.4900	38.7889	(250)
Additional standing charges			0.0000	(251)
Total energy cost			975.2102	(255)

EPC SAP Calculation Summary

11. SAP Rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.5459	(257)
SAP value		74.9408	
SAP rating (Section 12)		75	(258)
SAP band		C	

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	4092.8934	0.1542	631.0186	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1585.8285	0.1407	223.2051	(264)
Space and water heating			854.2237	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	235.2269	0.1443	33.9505	(268)
Total CO2, kg/year			888.1742	(272)
CO2 emissions per m2			4.8800	(273)
EI value			94.7593	
EI rating			95	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	182.1000 (1b)	x 3.3100 (2b)	= 602.7510 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	182.1000		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	602.7510 (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	5 * 10 =	50.0000	(7a)	
Number of passive vents	0 * 10 =	0.0000	(7b)	
Number of flueless gas fires	0 * 40 =	0.0000	(7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.0830 (8)
Pressure test				Yes
Pressure Test Method				Blower Door
Measured/design AP50				3.0000 (17)
Infiltration rate				0.2330 (18)
Number of sides sheltered				0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.2330 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000
Wind factor	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750
Adj infilt rate	0.3494	0.3261	0.3261	0.2912	0.2912	0.2562	0.2562	0.2504	0.2737	0.3145	0.3203	0.3436
Effective ac	0.5611	0.5532	0.5532	0.5424	0.5424	0.5328	0.5328	0.5314	0.5375	0.5495	0.5513	0.5590

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
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Window-New (Uw = 1.20)					38.8200	1.1450	44.4504					(27)
Half Glazing Door					12.8700	1.5000	19.3050					(26a)
Heatloss Floor 1					182.1000	0.1200	21.8520	110.0000	20031.0000			(28a)
GF-Wall	458.8000		51.6900		407.1100	0.1800	73.2798	0.0000	0.0000	0.0000		(29a)
Pitch Roof-1	80.8000				80.8000	0.1300	10.5040	0.0000	0.0000	0.0000		(30)
Pitch Roof-2	80.8000				80.8000	0.1300	10.5040	0.0000	0.0000	0.0000		(30)
Pitch Roof-3	28.8000				28.8000	0.1300	3.7440	0.0000	0.0000	0.0000		(30)
Pitch Roof-4	28.8000				28.8000	0.1300	3.7440	0.0000	0.0000	0.0000		(30)
Total net area of external elements Aum(A, m2)					860.1000							(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =		187.3832					(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 20031.0000 (34)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 110.0000 (35)

List of Thermal Bridges

K1 Element												
E1 Steel lintel with perforated steel base plate						Length	Psi-value	Total				
						25.1100	0.0000	0.0000				
						19.2600	0.0000	0.0000				
						83.0000	0.0000	0.0000				
E5 Ground floor (normal)						101.8500	0.0000	0.0000				
E16 Corner (normal)						13.2400	0.0000	0.0000				

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 0.0000 (36)  
Point Thermal bridges (36a) = 0.0000  
Total fabric heat loss (33) + (36) + (36a) = 187.3832 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
Heat transfer coeff	111.5973	110.0322	110.0322	107.8868	107.8868	105.9844	105.9844	105.6909	106.9053	109.2901	109.6578	111.1959	(38)
Average = Sum(39)m / 12 =	298.9805	297.4154	297.4154	295.2700	295.2700	293.3676	293.3676	293.0741	294.2884	296.6733	297.0409	298.5791	(39)
												295.8952	(39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	1.6418	1.6333	1.6333	1.6215	1.6215	1.6110	1.6110	1.6094	1.6161	1.6292	1.6312	1.6396	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	(40)

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.9786 (42)
Hot water usage for mixer showers													0.0000 (42a)
Hot water usage for baths	85.5535	84.2830	82.4937	79.1946	76.7243	73.9852	72.5056	74.2823	76.2169	79.1479	82.5149	85.2643	(42b)
Hot water usage for other uses	45.1335	43.4923	41.8511	40.2099	38.5687	36.9274	36.9274	38.5687	40.2099	41.8511	43.4923	45.1335	(42c)
Average daily hot water use (litres/day)													120.3521 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(44)
Energy conte	130.6871	127.7753	124.3448	119.4045	115.2930	110.9126	109.4330	112.8510	116.4267	120.9990	126.0072	130.3978	(44)
Energy content (annual)	206.9764	181.9503	191.1133	163.4588	155.2065	136.3800	132.3498	139.7331	143.5658	164.1945	179.5204	204.1715	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 1998.6202
Water storage loss:	31.0465	27.2925	28.6670	24.5188	23.2810	20.4570	19.8525	20.9600	21.5349	24.6292	26.9281	30.6257	(46)
Store volume													400.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7200 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9288 (55)
Total storage loss	28.7928	26.0064	28.7928	27.8640	28.7928	27.8640	28.7928	28.7928	27.8640	28.7928	27.8640	28.7928	(56)
If cylinder contains dedicated solar storage	28.7928	26.0064	28.7928	27.8640	28.7928	27.8640	28.7928	28.7928	27.8640	28.7928	27.8640	28.7928	(57)
Primary loss	37.2980	33.6885	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	36.0948	37.2980	36.0948	37.2980	(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	273.0671	241.6452	257.2041	227.4176	221.2973	200.3388	198.4405	205.8238	207.5246	230.2852	243.4792	270.2623	(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	273.0671	241.6452	257.2041	227.4176	221.2973	200.3388	198.4405	205.8238	207.5246	230.2852	243.4792	270.2623	(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)
Heat gains from water heating, kWh/month	121.6923	108.2544	116.4178	105.5171	104.4788	96.5134	96.8789	99.3339	98.9027	107.4673	110.8576	120.7596	(65)
													Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	33.2988	29.5757	24.0526	18.2093	13.6117	11.4916	12.4170	16.1401	21.6633	27.5065	32.1042	34.2243	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	527.9077	533.3858	519.5813	490.1932	453.0961	418.2300	394.9373	389.4593	403.2637	432.6518	469.7489	504.6150	(68)
Pumps, fans	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	(69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	(71)
Total internal gains	163.5649	161.0928	156.4755	146.5515	140.4285	134.0464	130.2136	133.5133	137.3648	144.4453	153.9688	162.3113	(72)
	843.1928	842.4756	818.5308	773.3755	725.5576	679.1893	652.9893	654.5341	677.7132	723.0249	774.2433	819.5720	(73)

6. Solar gains

[Jan]		Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
North		11.5500	14.1962	0.6300	0.7000	0.7700	50.1103 (74)					
East		1.5600	26.5726	0.6300	0.7000	0.7700	12.6687 (76)					
South		23.7900	59.2009	0.6300	0.7000	0.7700	430.4220 (78)					
West		1.9200	26.5726	0.6300	0.7000	0.7700	15.5922 (80)					
Solar gains	508.7932	721.3364	968.1863	1206.0402	1287.1145	1370.1016	1220.1594	1188.6091	1071.2887	803.5756	584.5882	420.9830 (83)
Total gains	1351.9859	1563.8121	1786.7171	1979.4157	2012.6721	2049.2909	1873.1487	1843.1431	1749.0019	1526.6006	1358.8315	1240.5551 (84)

Επίσης Σας παρατίθεται Πρωτόκολλο (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	18.6105	18.7084	18.7084	18.8443	18.8443	18.9665	18.9665	18.9855	18.9072	18.7552	18.7320	18.6355
alpha	2.2407	2.2472	2.2472	2.2563	2.2563	2.2644	2.2644	2.2657	2.2605	2.2503	2.2488	2.2424
util living area	0.9508	0.9331	0.9030	0.8548	0.7856	0.6683	0.5904	0.5883	0.7185	0.8596	0.9260	0.9565 (86)
MIT	18.7009	18.8919	19.2212	19.6549	20.1057	20.4954	20.6572	20.6635	20.4343	19.8938	19.2857	18.6974 (87)
Th 2	19.5828	19.5890	19.5890	19.5976	19.5976	19.6053	19.6053	19.6064	19.6016	19.5920	19.5905	19.5844 (88)
util rest of house	0.9408	0.9198	0.8835	0.8240	0.7338	0.5799	0.4645	0.4595	0.6317	0.8197	0.9080	0.9473 (89)
MIT 2	16.9940	17.2358	17.6457	18.1835	18.7237	19.1594	19.3188	19.3260	19.1049	18.4870	17.7383	16.9922 (90)
Living area fraction	fLA = Living area / (4) = 0.1636 (91)											
MIT	17.2733	17.5068	17.9035	18.4243	18.9498	19.3780	19.5378	19.5449	19.3225	18.7172	17.9915	17.2712 (92)
Temperature adjustment	0.0000											
adjusted MIT	17.2733	17.5068	17.9035	18.4243	18.9498	19.3780	19.5378	19.5449	19.3225	18.7172	17.9915	17.2712 (93)

8. Space heating requirement												
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9172	0.8924	0.8521	0.7911	0.7045	0.5630	0.4575	0.4529	0.6106	0.7869	0.8791	0.9252 (94)
Useful gains	1239.9825	1395.5714	1522.5171	1565.9754	1417.8973	1153.7074	856.9096	834.8224	1067.9227	1201.3579	1194.5009	1147.7810 (95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000 (96)
Heat loss rate W	3340.6012	3303.3244	3094.1584	2694.1221	2081.6093	1431.0581	979.2044	950.9927	1389.7627	2052.1468	2670.8513	3245.9232 (97)
Space heating kWh	1562.8603	1282.0100	1169.3011	812.2656	493.8017	0.0000	0.0000	0.0000	0.0000	632.9870	1062.9723	1561.0178 (98a)
Space heating requirement - total per year (kWh/year)	8577.2159											
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	1562.8603	1282.0100	1169.3011	812.2656	493.8017	0.0000	0.0000	0.0000	0.0000	632.9870	1062.9723	1561.0178 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	8577.2159											
Space heating per m <sup>2</sup>	(98c) / (4) = 47.1017 (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 %)	249.9000 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	0.0000 (208)											
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1562.8603	1282.0100	1169.3011	812.2656	493.8017	0.0000	0.0000	0.0000	0.0000	632.9870	1062.9723	1561.0178 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system)	625.3943	513.0092	467.9076	325.0362	197.5997	0.0000	0.0000	0.0000	0.0000	253.2961	425.3591	624.6570 (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	273.0671	241.6452	257.2041	227.4176	221.2973	200.3388	198.4405	205.8238	207.5246	230.2852	243.4792	270.2623 (64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	155.9493	138.0041	146.8898	129.8787	126.3834	114.4139	113.3298	117.5465	118.5178	131.5164	139.0515	154.3474 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	29.1462	23.3822	21.0531	15.4244	11.9142	9.7340	10.8686	14.1274	18.3501	24.0763	27.1941	29.9563 (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	3432.2592 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	175.1000
Water heating fuel used	1585.8285 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	235.2269 (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)
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	5253.3146 (238)

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10a. Fuel costs - using BEDF prices (535)  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3432.2592	25.1600	863.5564 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1585.8285	25.1600	398.9944 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	235.2269	25.1600	59.1831 (250)
Additional standing charges			0.0000 (251)
Total energy cost			1321.7340 (255)

-----  
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	3432.2592	0.1540	528.6705 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1585.8285	0.1407	223.2051 (264)
Space and water heating			751.8756 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	235.2269	0.1443	33.9505 (268)
Total CO2, kg/year			785.8261 (272)

-----  
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	3432.2592	1.5703	5389.5373 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1585.8285	1.5204	2411.1479 (278)
Space and water heating			7800.6852 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	235.2269	1.5338	360.7989 (282)
Total Primary energy kWh/year			8161.4841 (286)

-----  
SAP 10 EPC IMPROVEMENTS  
-----

Cart Shed -ASHP

Current energy efficiency rating: C 75  
Current environmental impact rating: A 95

N Solar water heating			Recommended
U Solar photovoltaic panels			Recommended
V2 Wind turbine			Recommended
Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.4	-£ 101	-50 kg (6.4%)
U Solar photovoltaic panels	+ 4.2	-£ 272	-146 kg (19.9%)
V2 Wind turbine	+ 10.6	-£ 630	-347 kg (58.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£101	0.28 kg/m <sup>2</sup>	C 76 A 95
Solar photovoltaic panels	£272	0.80 kg/m <sup>2</sup>	B 81 A 96
Wind turbine	£630	1.91 kg/m <sup>2</sup>	B 91 A 98
Total Savings	£1003	2.99 kg/m <sup>2</sup>	

Potential energy efficiency rating: B 91  
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South West England):			
	Current	Potential	Saving
Electricity	£1322	£1221	£101
Space heating	£864	£885	-£21
Water heating	£399	£277	£122



HLP	1.6233	1.6215	1.6196	1.6110	1.6094	1.6019	1.6019	1.6005	1.6048	1.6094	1.6127	1.6161 (40)
HLP (average)												1.6110
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9786 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	85.5535	84.2830	82.4937	79.1946	76.7243	73.9852	72.5056	74.2823	76.2169	79.1479	82.5149	85.2643 (42b)
Hot water usage for other uses												45.1335 (42c)
Average daily hot water use (litres/day)												120.3521 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	130.6871	127.7753	124.3448	119.4045	115.2930	110.9126	109.4330	112.8510	116.4267	120.9990	126.0072	130.3978 (44)
Energy content	206.9764	181.9503	191.1133	163.4588	155.2065	136.3800	132.3498	139.7331	143.5658	164.1945	179.5204	204.1715 (45)
Energy content (annual)												Total = Sum(45)m = 1998.6202
Distribution loss (46)m = 0.15 x (45)m												30.6257 (46)
Water storage loss:												400.0000 (47)
Store volume												1.7200 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.9288 (55)
Enter (49) or (54) in (55)												
Total storage loss												28.7928 (56)
If cylinder contains dedicated solar storage												28.7928 (57)
Primary loss	37.2980	33.6885	35.0601	25.2664	16.7841	15.8817	16.4111	17.9030	27.4320	35.0601	36.0948	37.2980 (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												270.2623 (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)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												621.1991 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												621.1991
Solar input	-0.0000	-16.2068	-58.4012	-80.2017	-104.3180	-96.2042	-95.5923	-83.6615	-57.9193	-28.6941	-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	273.0671	225.4383	196.5650	136.3875	96.4654	83.9214	81.9614	102.7674	140.9426	199.3532	243.4792	270.2623 (64)
												Total per year (kWh/year) = Sum(64)m = 2050.6108 (64)
Electric shower(s)												0.0000 (64a)
												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month	121.6923	108.2544	114.6275	96.8543	88.0677	80.3429	80.1694	83.8179	91.9725	105.6770	110.8576	120.7596 (65)

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

Metabolic gains (Table 5), Watts												178.7142 (66)
(66)m	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												34.2243 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												504.6150 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												55.8500 (69)
Pumps, fans												3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												-119.1428 (71)
Water heating gains (Table 5)												162.3113 (72)
Total internal gains	843.1928	842.4756	816.1244	761.3439	703.4997	656.7303	630.5303	633.6793	668.0879	720.6186	774.2433	819.5720 (73)

6. Solar gains

[Jan]			Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
North			11.5500	10.6334	0.6300	0.7000	0.7700	37.5341 (74)				
East			1.5600	19.6403	0.6300	0.7000	0.7700	9.3636 (76)				
South			23.7900	46.7521	0.6300	0.7000	0.7700	339.9124 (78)				
West			1.9200	19.6403	0.6300	0.7000	0.7700	11.5245 (80)				
Solar gains	398.3346	669.2800	898.3021	1095.3861	1219.1856	1209.2020	1166.1206	1072.4596	965.5738	734.3116	475.2602	342.1832 (83)
Total gains	1241.5273	1511.7557	1714.4265	1856.7299	1922.6853	1865.9323	1796.6509	1706.1389	1633.6618	1454.9302	1249.5035	1161.7553 (84)





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	2087.4596 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4097.0897	16.4900	675.6101 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1171.1084	16.4900	193.1158 (247)
Water heating (other fuel) - electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	235.2269	16.4900	38.7889 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-993.0869	16.4900	-163.7600
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-163.7600 (252)
Wind Turbine electricity used in dwelling	-2502.8785	16.4900	-412.7247
Wind Turbine electricity exported	0.0000	5.5900	0.0000
Total			-412.7247 (252)
Total energy cost			344.2221 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.5457 (257)
SAP value		91.1548
SAP rating (Section 12)		91 (258)
SAP band		B

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	4097.0897	0.1542	631.5975 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1171.1084	0.1457	170.5852 (264)
Space and water heating			802.1827 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	235.2269	0.1443	33.9505 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-993.0869	0.1346	-133.6206
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-133.6206 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-347.1801 (269)
Total CO2, kg/year			366.4295 (272)
CO2 emissions per m2			2.0100 (273)
EI value			97.8379
EI rating			98 (274)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	182.1000 (1b)	x 3.3100 (2b)	= 602.7510 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	182.1000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	602.7510 (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	5 * 10 = 50.0000 (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) = 50.0000 / (5) = 0.0830 (8)  
 Pressure test Yes  
 Pressure Test Method Blower Door  
 Measured/design AP50 3.0000 (17)  
 Infiltration rate 0.2330 (18)  
 Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2330 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000 (22)
Wind factor	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750 (22a)
Adj infilt rate	0.3434	0.3261	0.3261	0.2912	0.2912	0.2562	0.2562	0.2504	0.2737	0.3145	0.3203	0.3436 (22b)
			0.5532	0.5424	0.5424	0.5328	0.5328	0.5314	0.5375	0.5495	0.5513	0.5590 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window-New (Uw = 1.20)			38.8200	1.1450	44.4504		(27)
Half Glazing Door			12.8700	1.5000	19.3050		(26a)
Heatloss Floor 1			182.1000	0.1200	21.8520	110.0000	20031.0000 (28a)
GF-Wall	458.8000	51.6900	407.1100	0.1800	73.2798	0.0000	0.0000 (29a)
Pitch Roof-1	80.8000		80.8000	0.1300	10.5040	0.0000	0.0000 (30)
Pitch Roof-2	80.8000		80.8000	0.1300	10.5040	0.0000	0.0000 (30)
Pitch Roof-3	28.8000		28.8000	0.1300	3.7440	0.0000	0.0000 (30)
Pitch Roof-4	28.8000		28.8000	0.1300	3.7440	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m2)			860.1000				(31)
Fabric heat loss, W/K = Sum (A x U)					187.3832		(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 20031.0000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 110.0000 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	25.1100	0.0000	0.0000
E3 Sill	19.2600	0.0000	0.0000
E4 Jamb	83.0000	0.0000	0.0000
E5 Ground floor (normal)	101.8500	0.0000	0.0000
E16 Corner (normal)	13.2400	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 0.0000 (36)  
 Point Thermal bridges 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 187.3832 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	111.5973	110.0322	110.0322	107.8868	107.8868	105.9844	105.9844	105.6909	106.9053	109.2901	109.6578	111.1959 (38)
Average = Sum(39)m / 12 =	298.9805	297.4154	297.4154	295.2700	295.2700	293.3676	293.3676	293.0741	294.2884	296.6733	297.0409	298.5791 (39)
												295.8952

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.6418	1.6333	1.6333	1.6215	1.6215	1.6110	1.6110	1.6094	1.6161	1.6292	1.6312	1.6396 (40)
HLP (average)												1.6249
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												2.9786 (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	85.5535	84.2830	82.4937	79.1946	76.7243	73.9852	72.5056	74.2823	76.2169	79.1479	82.5149	85.2643 (42b)
Hot water usage for other uses	45.1335	43.4923	41.8511	40.2099	38.5687	36.9274	36.9274	38.5687	40.2099	41.8511	43.4923	45.1335 (42c)
Average daily hot water use (litres/day)												120.3521 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	130.6871	127.7753	124.3448	119.4045	115.2930	110.9126	109.4330	112.8510	116.4267	120.9990	126.0072	130.3978 (44)
Energy conte	206.9764	181.9503	191.1133	163.4588	155.2065	136.3800	132.3498	139.7331	143.5658	164.1945	179.5204	204.1715 (45)
Energy content (annual)										Total = Sum(45)m =		1998.6202

Distribution loss (46)m = 0.15 x (45)m 31.0465 27.2925 28.6670 24.5188 23.2810 20.4570 19.8525 20.9600 21.5349 24.6292 26.9281 30.6257 (46)

Water storage loss: Store volume 400.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7200 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9288 (55)

Total storage loss 28.7928 26.0064 28.7928 27.8640 28.7928 27.8640 28.7928 28.7928 27.8640 28.7928 27.8640 28.7928 (56)

If cylinder contains dedicated solar storage 28.7928 26.0064 28.7928 27.8640 28.7928 27.8640 28.7928 28.7928 27.8640 28.7928 27.8640 28.7928 (57)

Primary loss 37.2980 33.6885 35.0601 25.2664 16.7841 15.8817 16.4111 17.9030 27.4320 35.0601 36.0948 37.2980 (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 273.0671 241.6452 254.9662 216.5892 200.7834 180.1257 177.5537 186.4289 198.8619 228.0474 243.4792 270.2623 (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)

FV 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)

Aperture area of solar collector 3.0000 (H1)

Zero-loss collector efficiency 0.8000 (H2)

Collector linear heat loss coefficient 1.8000 (H3)

Collector 2nd order heat loss coefficient 0.0000 (H4)

Collector loop efficiency 0.9000 (H5)

Incidence angle modifier 1.0000 (H6)

Overshading factor 0.8000 (H8)

Overall heat loss coefficient of system 6.5000 (H10)

Heat loss coefficient of collector loop 3.9667 (H11)

Dedicated solar storage volume 75.0000 (H12)

Effective solar volume 75.0000 (H14)

Reference volume 225.0000 (H15)

Storage tank correction coefficient 1.3161 (H16)

Heat delivered to hot water													742.7445 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													742.7445
Solar input	-7.1307	-24.5147	-70.5544	-94.4100	-113.1602	-111.4754	-101.7539	-97.1701	-71.6095	-40.0245	-10.9409		-0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000 (63d)
Output from w/h	265.9364	217.1304	184.4118	122.1791	87.6231	68.6503	75.7998	89.2588	127.2524	188.0228	232.5382		270.2623 (64)
													1929.0655 (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)
													0.0000 (64a)
Heat gains from water heating, kWh/month	121.6923	108.2544	114.6275	96.8543	88.0677	80.3429	80.1694	83.8179	91.9725	105.6770	110.8576		120.7596 (65)

Energy Gain Calculations Summary



5. Internal gains (see Tables 5 and 5a)													
Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	178.7142	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.2988	29.5757	24.0526	18.2093	13.6117	11.4916	12.4170	16.1401	21.6633	27.5065	32.1042	34.2243	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	527.9077	533.3858	519.5813	490.1932	453.0961	418.2300	394.9373	389.4593	403.2637	432.6518	469.7489	504.6150	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	55.8500	(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)	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	-119.1428	(71)
Water heating gains (Table 5)	163.5649	161.0928	154.0692	134.5199	118.3705	111.5874	107.7546	112.6585	127.7395	142.0389	153.9688	162.3113	(72)
Total internal gains	843.1928	842.4756	816.1244	761.3439	703.4997	656.7303	630.5303	633.6793	668.0879	720.6186	774.2433	819.5720	(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		11.5500	14.1962	0.6300	0.7000	0.7700	50.1103 (74)						
East		1.5600	26.5726	0.6300	0.7000	0.7700	12.6687 (76)						
South		23.7900	59.2009	0.6300	0.7000	0.7700	430.4220 (78)						
West		1.9200	26.5726	0.6300	0.7000	0.7700	15.5922 (80)						
Solar gains	508.7932	721.3364	968.1863	1206.0402	1287.1145	1370.1016	1220.1594	1188.6091	1071.2887	803.5756	584.5882	420.9830	(83)
Total gains	1351.9859	1563.8121	1784.3108	1967.3841	1990.6142	2026.8319	1850.6897	1822.2884	1739.3766	1524.1942	1358.8315	1240.5551	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													
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	18.6105	18.7084	18.7084	18.8443	18.8443	18.9665	18.9665	18.9855	18.9072	18.7552	18.7320	18.6355	
alpha	2.2407	2.2472	2.2472	2.2563	2.2563	2.2644	2.2644	2.2657	2.2605	2.2503	2.2488	2.2424	
util living area	0.9508	0.9331	0.9033	0.8561	0.7887	0.6723	0.5949	0.5925	0.7204	0.8599	0.9260	0.9565	(86)
MIT	18.7009	18.8919	19.2200	19.6497	20.0982	20.4906	20.6538	20.6603	20.4317	19.8928	19.2857	18.6974	(87)
Th 2	19.5828	19.5890	19.5890	19.5976	19.5976	19.6053	19.6053	19.6064	19.6016	19.5920	19.5905	19.5844	(88)
util rest of house	0.9408	0.9198	0.8837	0.8256	0.7374	0.5840	0.4688	0.4636	0.6337	0.8201	0.9080	0.9473	(89)
MIT 2	16.9940	17.2358	17.6442	18.1775	18.7157	19.1552	19.3166	19.3240	19.1026	18.4858	17.7383	16.9922	(90)
Living area fraction									FLA = Living area / (4) =				0.1636 (91)
MIT	17.2733	17.5068	17.9021	18.4184	18.9419	19.3738	19.5354	19.5427	19.3201	18.7160	17.9915	17.2712	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2733	17.5068	17.9021	18.4184	18.9419	19.3738	19.5354	19.5427	19.3201	18.7160	17.9915	17.2712	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9172	0.8924	0.8524	0.7927	0.7079	0.5667	0.4615	0.4567	0.6124	0.7874	0.8791	0.9252	(94)
Useful gains	1239.9825	1395.5714	1520.9572	1559.5198	1409.0683	1148.7020	854.0356	832.2279	1065.2719	1200.0851	1194.5009	1147.7810	(95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000	(96)
Heat loss rate W	3340.6012	3303.3244	3093.7351	2692.3829	2079.2762	1429.8008	978.4963	950.3533	1389.0816	2051.8021	2670.8513	3245.9232	(97)
Space heating kWh	1562.8603	1282.0100	1170.1467	815.6614	498.6347	0.0000	0.0000	0.0000	0.0000	633.6775	1062.9723	1561.0178	(98a)
Space heating requirement - total per year (kWh/year)												8586.9808	
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	1562.8603	1282.0100	1170.1467	815.6614	498.6347	0.0000	0.0000	0.0000	0.0000	633.6775	1062.9723	1561.0178	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8586.9808	
Space heating per m2												47.1553	(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 %)		249.9000	(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	1562.8603	1282.0100	1170.1467	815.6614	498.6347	0.0000	0.0000	0.0000	0.0000	633.6775	1062.9723	1561.0178	(98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)
Space heating fuel (main heating system)	625.3943	513.0092	468.2460	326.3951	199.5337	0.0000	0.0000	0.0000	0.0000	253.5724	425.3591	624.6570	(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 requirement													
Efficiency of water heating (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)
Fuel for water heating, kWh/month	151.8769	124.0037	105.3180	69.7768	50.0418	39.2063	43.2894	50.9759	72.6741	107.3802	132.8031	154.3474	(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	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	29.1462	23.3822	21.0531	15.4244	11.9142	9.7340	10.8686	14.1274	18.3501	24.0763	27.1941	29.9563	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-52.5815	-69.2949	-106.5723	-127.0798	-132.4768	-112.3292	-106.5039	-103.0099	-91.1988	-80.5596	-57.1229	-43.3252	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	(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												3436.1668	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												175.1000	
Water heating fuel used												1101.6936	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												235.2269	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1082.0548	(233)
Wind generation												-3575.5408	(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												1268.1540	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3436.1668	25.1600	864.5396	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1101.6936	25.1600	277.1861	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	235.2269	25.1600	59.1831	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1082.0548	25.1600	-272.2450	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-272.2450	(252)
Wind Turbine electricity used in dwelling	-2502.8785	25.1600	-629.7242	
Wind Turbine electricity exported	0.0000	5.8100	0.0000	
Total			-629.7242	(252)
Total energy cost			319.0675	(255)

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	3436.1668	0.1540	529.2095	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1101.6936	0.1463	161.1948	(264)
Space and water heating			690.4043	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	235.2269	0.1443	33.9505	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1082.0548	0.1351	-146.2313	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-146.2313	(269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801	
Wind Turbine electricity exported	0.0000	0.0000	0.0000	
Total			-347.1801	(269)
Total CO2, kg/year			242.0403	(272)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3436.1668	1.5702	5395.4384 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1101.6936	1.5413	1698.0023 (278)
Space and water heating			7093.4406 (279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240 (281)
Energy for lighting	235.2269	1.5338	360.7989 (282)
Energy saving/generation technologies			
Photovoltaic electricity exported	-1082.0548	1.4995	-1622.5424
Total	0.0000	0.0000	0.0000
Wind Turbine electricity used in dwelling	-2502.8785	1.5128	-1622.5424 (283)
Wind Turbine electricity exported	0.0000	0.0000	-3786.3546
Total			0.0000
Total Primary energy kWh/year			-3786.3546 (283)
			2166.3664 (286)

Property Reference	2324 Main House Improved		Issued on Date	23/01/2024	
Assessment Reference	Main House-ASHP	Prop Type Ref			
Property					
SAP Rating	67 D	DER		TER	
Environmental	93 A	% DER < TER			N/A
CO <sub>2</sub> Emissions (t/year)	5.1	DFEE		TFEE	
Compliance Check	See BREL	% DFEE < TFEE			
% DPER < TPER		DPER		TPER	
Client	Mr. Abdul Mohammed		Assessor ID	K333-0001	

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING

1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Basement floor	93.7000 (1a)	x 2.1000 (2a)	= 196.7700 (1a) - (3a)
Ground floor	469.1000 (1b)	x 3.1400 (2b)	= 1472.9740 (1b) - (3b)
First floor	307.5000 (1c)	x 3.1400 (2c)	= 965.5500 (1c) - (3c)
Second floor	99.2000 (1d)	x 2.3000 (2d)	= 228.1600 (1d) - (3d)
Third floor	44.2000 (1e)	x 2.5000 (2e)	= 110.5000 (1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	1013.7000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 2973.9540 (5)

2. Ventilation rate

	m <sup>3</sup> 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	2 * 10 = 20.0000 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	60.0000 / (5) = 0.0202 (8)
Number of storeys in the dwelling (ns)	5 (9)
Additional infiltration	[(9) - 1] x 0.1 = 0.4000 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0.3500 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0.0000 (12)
If no draught lobby, enter 0.05, else enter 0	0.0500 (13)
Percentage of windows and doors draught stripped	100.0000 (14)
Window infiltration	0.25 - [0.2 * (14) / 100] = 0.0500 (15)
Pressure test	No Blower Door
Pressure Test Method	15.0000 (17)
Measured/design AP50	0.8702 (18)
Infiltration rate	0 (19)
Number of sides sheltered	
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.8702 (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	1.1095	1.0877	1.0660	0.9572	0.9354	0.8267	0.8267	0.8049	0.8702	0.9354	0.9789	1.0225 (22b)
Effective ac	1.1095	1.0877	1.0660	0.9581	0.9375	0.8417	0.8417	0.8239	0.8786	0.9375	0.9792	1.0225 (25)

3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window-Existing (Uw = 4.80)			66.5200	4.0268	267.8658		(27)
Window-New (Uw = 1.56)			120.3700	1.4684	176.7481		(27)
Door-Glazing			6.7200	1.6000	10.7520		(26a)
Door			6.7200	1.4000	9.4080		(26)
PR-9-S-Skylight for AB			2.5400	1.5038	3.8195		(27a)
PR-8-N-Skylight for AB			2.5400	1.5038	3.8195		(27a)
PR-1-N-Skylight for MH			5.0600	1.5038	7.6090		(27a)



Water heating gains (Table 5)	187.6971	184.6186	178.8686	166.5100	158.8848	150.9370	146.1640	150.2731	155.0696	163.8870	175.7469	186.1360 (72)
Total internal gains	1821.5575	1819.9724	1759.4303	1650.6756	1530.8796	1422.0422	1359.8904	1362.5061	1422.0947	1530.3082	1654.3390	1762.6176 (73)

6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.5200	10.6334	0.8500	0.7000	0.7700	32.9716 (74)
North	11.7200	19.6403	0.8500	0.7000	0.7700	94.9129 (76)
South	6.3500	36.7938	0.8500	0.7000	0.7700	96.3383 (77)
South	10.5500	46.7521	0.8500	0.7000	0.7700	203.3778 (78)
Southwest	6.0300	36.7938	0.8500	0.7000	0.7700	91.4835 (79)
West	17.6200	19.6403	0.8500	0.7000	0.7700	142.6932 (80)
Northwest	6.7300	11.2829	0.8500	0.7000	0.7700	31.3103 (81)
North	29.6600	10.6334	0.6300	0.7000	0.7700	96.3862 (74)
Northeast	4.2100	11.2829	0.6300	0.7000	0.7700	14.5170 (75)
East	12.4200	19.6403	0.6300	0.7000	0.7700	74.5488 (76)
Southeast	13.6800	36.7938	0.6300	0.7000	0.7700	153.8271 (77)
South	36.0500	46.7521	0.6300	0.7000	0.7700	515.0838 (78)
Southwest	4.2100	36.7938	0.6300	0.7000	0.7700	47.3401 (79)
West	15.9300	19.6403	0.6300	0.7000	0.7700	95.6170 (80)
Northwest	4.2100	11.2829	0.6300	0.7000	0.7700	14.5170 (81)
North	10.1400	26.0000	0.6300	0.7000	1.0000	104.6387 (82)
South	47.7100	26.0000	0.6300	0.7000	1.0000	492.3386 (82)

Solar gains	2301.9018	4246.8531	6564.7142	9215.5388	11177.4364	11437.5840	10887.7485	9395.2567	7490.4303	4907.7479	2819.1948	1928.3353 (83)
Total gains	4123.4592	6066.8255	8324.1444	10866.2144	12708.3160	12859.6263	12247.6389	10757.7628	8912.5250	6438.0561	4473.5338	3690.9530 (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	4.9130	4.9517	4.9910	5.1955	5.2365	5.4359	5.4359	5.4745	5.3573	5.2365	5.1543	5.0715	
alpha	1.3275	1.3301	1.3327	1.3464	1.3491	1.3624	1.3624	1.3650	1.3572	1.3491	1.3436	1.3381	
util living area	0.9625	0.9370	0.8968	0.8283	0.7411	0.6351	0.5420	0.5908	0.7505	0.8843	0.9468	0.9671 (86)	
MIT	14.7919	15.3042	16.2359	17.5173	18.7284	19.7578	20.3123	20.1942	19.2972	17.6975	16.0336	14.7344 (87)	
Th 2	18.9102	18.9218	18.9335	18.9927	19.0042	19.0586	19.0586	19.0688	19.0375	19.0042	18.9810	18.9572 (88)	
util rest of house	0.9557	0.9258	0.8775	0.7941	0.6813	0.5316	0.3770	0.4334	0.6672	0.8540	0.9357	0.9613 (89)	
MIT 2	12.4516	13.0654	14.1751	15.7004	17.0915	18.2389	18.7730	18.6970	17.7917	15.9552	13.9677	12.3986 (90)	
Living area fraction	fLA = Living area / (4) = 0.2034 (91)												
MIT	12.9276	13.5208	14.5943	16.0700	17.4245	18.5478	19.0861	19.0016	18.0979	16.3096	14.3879	12.8738 (92)	
Temperature adjustment	0.0000												
adjusted MIT	12.9276	13.5208	14.5943	16.0700	17.4245	18.5478	19.0861	19.0016	18.0979	16.3096	14.3879	12.8738 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9170	0.8713	0.8081	0.7176	0.6152	0.4962	0.3799	0.4263	0.6091	0.7836	0.8865	0.9262 (94)
Useful gains	3781.3053	5285.9439	6726.7668	7797.9535	7817.5661	6380.8444	4653.4623	4585.5125	5428.6064	5044.7618	3965.8861	3418.7040 (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	23571.1587	23368.4087	21768.4672	18523.7329	14673.5176	9748.1620	6138.8855	6378.6275	10016.7261	14635.3766	18979.0167	22956.4999 (97)
Space heating kWh	14723.6509	12151.4163	11191.0251	7722.5612	5100.8279	0.0000	0.0000	0.0000	0.0000	7135.4174	10809.4541	14536.1201 (98a)
Space heating requirement - total per year (kWh/year)												83370.4730
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	14723.6509	12151.4163	11191.0251	7722.5612	5100.8279	0.0000	0.0000	0.0000	0.0000	7135.4174	10809.4541	14536.1201 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												83370.4730
Space heating per m <sup>2</sup>												(98c) / (4) = 82.2437 (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 %)													249.9000 (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	14723.6509	12151.4163	11191.0251	7722.5612	5100.8279	0.0000	0.0000	0.0000	0.0000	7135.4174	10809.4541	14536.1201 (98)	
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)	
Space heating fuel (main heating system)	5891.8171	4862.5115	4478.2013	3090.2606	2041.1476	0.0000	0.0000	0.0000	0.0000	2855.3091	4325.5118	5816.7748 (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	325.1823	287.4912	305.4277	268.8137	260.7121	235.0918	232.2481	241.4427	244.0405	271.9050	288.8155	321.6893 (64)	
Efficiency of water heater													175.1000 (216)



(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	185.7123	164.1869	174.4304	153.5201	148.8933	134.2615	132.6374	137.8885	139.3721	155.2856	164.9432	183.7175	164.9432	(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	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	99.7835	80.0500	72.0761	52.8061	40.7889	33.3249	37.2090	48.3657	62.8223	82.4262	93.1002	102.5567	102.5567	(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	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	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	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	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	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	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	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	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													33361.5338	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.1000	
Water heating fuel used													1874.8487	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
Total electricity for the above, kWh/year													0.0000	(231)
Electricity for lighting (calculated in Appendix L)													805.3097	(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													36041.6922	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	33361.5338	16.4900	5501.3169	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1874.8487	16.4900	309.1626	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	805.3097	16.4900	132.7956	(250)
Additional standing charges			0.0000	(251)
Total energy cost			5943.2750	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	2.0209	(257)
SAP value		67.2404	
SAP rating (Section 12)		67	(258)
SAP band		D	

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	33361.5338	0.1536	5124.4802	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1874.8487	0.1409	264.0884	(264)
Space and water heating			5388.5686	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	805.3097	0.1443	116.2311	(268)
Total CO2, kg/year			5504.7997	(272)
CO2 emissions per m2			5.4300	(273)
EI value			93.0326	
EI rating			93	(274)
EI band			A	

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Basement floor	93.7000 (1a)	x 2.1000 (2a)	= 196.7700 (1a) - (3a)	

Ground floor	469.1000 (1b)	x	3.1400 (2b)	=	1472.9740 (1b) - (3b)
First floor	307.5000 (1c)	x	3.1400 (2c)	=	965.5500 (1c) - (3c)
Second floor	99.2000 (1d)	x	2.3000 (2d)	=	228.1600 (1d) - (3d)
Third floor	44.2000 (1e)	x	2.5000 (2e)	=	110.5000 (1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	1013.7000				(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 2973.9540 (5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of chimneys / flues attached to closed fire	0 * 20 =	0.0000	(6b)
Number of flues attached to solid fuel boiler	2 * 10 =	20.0000	(6c)
Number of flues attached to other heater	0 * 20 =	0.0000	(6d)
Number of blocked chimneys	0 * 35 =	0.0000	(6e)
Number of intermittent extract fans	0 * 20 =	0.0000	(6f)
Number of passive vents	4 * 10 =	40.0000	(7a)
Number of flueless gas fires	0 * 10 =	0.0000	(7b)
	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)	60.0000 / (5) =	0.0202	(8)
Number of storeys in the dwelling (ns)		5	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.4000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test			No
Pressure Test Method			Blower Door
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8702	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8702	(21)

Wind speed	Jan 6.0000	Feb 5.6000	Mar 5.6000	Apr 5.0000	May 5.0000	Jun 4.4000	Jul 4.4000	Aug 4.3000	Sep 4.7000	Oct 5.4000	Nov 5.5000	Dec 5.9000	(22)
Wind factor	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750	(22a)
Adj infilt rate													
Effective ac	1.3053	1.2182	1.2182	1.0877	1.0877	0.9572	0.9572	0.9354	1.0225	1.1747	1.1965	1.2835	(22b)
	1.3053	1.2182	1.2182	1.0877	1.0877	0.9581	0.9581	0.9375	1.0225	1.1747	1.1965	1.2835	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Window-Existing (Uw = 4.80)			66.5200	4.0268	267.8658		(27)						
Window-New (Uw = 1.56)			120.3700	1.4684	176.7481		(27)						
Door-Glazing			6.7200	1.6000	10.7520		(26a)						
Door			6.7200	1.4000	9.4080		(26)						
FR-9-S-Skylight for AB			2.5400	1.5038	3.8195		(27a)						
FR-8-N-Skylight for AB			2.5400	1.5038	3.8195		(27a)						
FR-1-N-Skylight for MH			5.0600	1.5038	7.6090		(27a)						
FR-3-S-Skylight for MH			37.5700	1.5038	56.4962		(27a)						
FR9-S-Skyroof for AB			2.5400	1.5038	3.8195		(27a)						
FR8-N-Skyroof for AB			2.5400	1.5038	3.8195		(27a)						
FR3-S-Skyroof			5.0600	1.5038	7.6090		(27a)						
Heatloss Floor 1			93.7000	0.1200	11.2440	75.0000	7027.5000 (28)						
Heatloss Floor 2			375.4000	0.2500	93.8500	110.0000	41294.0000 (28a)						
BF-Wall Existing	81.1100	1.8000	79.3100	0.3100	24.5861	0.0000	0.0000 (29a)						
GF-Wall Existing	163.9400	42.1000	121.8400	1.0200	124.2768	0.0000	0.0000 (29a)						
1F-Wall Existing	100.3100	17.7600	82.5500	1.0200	84.2010	0.0000	0.0000 (29a)						
2F-Wall Existing	92.0200	15.5400	76.4800	1.0200	78.0096	0.0000	0.0000 (29a)						
3F-Wall Existing	61.4200	54.5600	6.8600	1.6000	10.9760	0.0000	0.0000 (29a)						
GF-Wall_Improved AB	197.7200	44.8400	152.8800	0.5000	76.4400	0.0000	0.0000 (29a)						
1F-Wall_Improved AB	217.7500	17.9800	199.7700	0.5000	99.8850	0.0000	0.0000 (29a)						
GF-Wall_New Build	68.7700	5.7500	63.0200	0.1800	11.3436	0.0000	0.0000 (29a)						
Pitch Roof-1	19.2000		19.2000	0.1600	3.0720	0.0000	0.0000 (30)						
Pitch Roof-2	19.2000		19.2000	0.1600	3.0720	0.0000	0.0000 (30)						
Pitch Roof-3	31.1000		31.1000	0.1600	4.9760	0.0000	0.0000 (30)						
Pitch Roof-4	33.0000		33.0000	0.1600	5.2800	0.0000	0.0000 (30)						
Flat Roof-1	36.3000	5.0600	31.2400	0.1600	4.9984	0.0000	0.0000 (30)						
Pitch Roof-5	11.4000		11.4000	0.1300	1.4820	0.0000	0.0000 (30)						
Pitch Roof-6	12.1000		12.1000	0.1300	1.5730	0.0000	0.0000 (30)						
Pitch Roof-7	11.4000		11.4000	0.1300	1.4820	0.0000	0.0000 (30)						
Pitch Roof-8	131.3000	2.5400	128.7600	0.1300	16.7388	0.0000	0.0000 (30)						
Pitch Roof-9	128.9000	7.6200	121.2800	0.1300	15.7664	0.0000	0.0000 (30)						
Flat Roof-2	88.6000		88.6000	0.1600	14.1760	0.0000	0.0000 (30)						
Flat Roof-3	44.2000		44.2000	0.1600	7.0720	0.0000	0.0000 (30)						
Total net area of external elements Aum(A, m2)			2018.8400				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	1239.4463	(33)						
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =	48321.5000	(34)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K						47.6684	(35)						
Thermal bridges (Default value 0.200 * total exposed area)						403.7680	(36)						
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss					(33) + (36) + (36a) =	1643.2143	(37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 1280.9911	Feb 1195.5917	Mar 1195.5917	Apr 1067.4926	May 1067.4926	Jun 940.2927	Jul 940.2927	Aug 920.0890	Sep 1003.4431	Oct 1152.8920	Nov 1174.2419	Dec 1259.6413	(38)
Heat transfer coeff	2924.2054	2838.8060	2838.8060	2710.7069	2710.7069	2583.5070	2583.5070	2563.3033	2646.6573	2796.1063	2817.4562	2902.8556	(39)
Average = Sum(39)m / 12 =												2743.0520	
HLP	Jan 2.8847	Feb 2.8004	Mar 2.8004	Apr 2.6741	May 2.6741	Jun 2.5486	Jul 2.5486	Aug 2.5287	Sep 2.6109	Oct 2.7583	Nov 2.7794	Dec 2.8636	(40)

HLP (average)													2.7060
Days in mont	31	28	31	30	31	30	31	31	30	31	30		31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												4.0597 (42)	
Hot water usage for mixer showers												0.0000 (42a)	
Hot water usage for baths												106.5418 (42b)	
Hot water usage for other uses												56.2058 (42c)	
Hot water usage for other uses												54.1620 (43)	
Επιπλέον απαιτήσεις Πυροσφίξης (lres/day)												52.1181 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	162.7476	159.1214	154.8494	148.6971	143.5769	138.1219	136.2794	140.5359	144.9888	150.6827	156.9196	162.3874	(44)
Energy conte	257.7523	226.5868	237.9977	203.5589	193.2822	169.8370	164.8181	174.0128	178.7857	204.4751	223.5607	254.2594	(45)
Energy content (annual)												Total = Sum(45)m = 2488.9267	
Distribution loss (46)m = 0.15 x (45)m												38.6629 (46)	
Water storage loss:												33.9880 (47)	
Store volume												300.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.8000 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												0.9720 (55)	
Total storage loss												30.1320 (56)	
If cylinder contains dedicated solar storage												30.1320 (57)	
Primary loss												37.2980 (59)	
Combi loss												0.0000 (61)	
Total heat required for water heating calculated for each month												325.1823 (62)	
WWHRS												0.0000 (63a)	
PV diverter												0.0000 (63b)	
Solar input												0.0000 (63c)	
FGHRS												0.0000 (63d)	
Output from w/h												325.1823 (64)	
Electric shower(s)												0.0000 (64a)	
Heat gains from water heating, kWh/month												139.6466 (65)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)													

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

Metabolic gains (Table 5), Watts												(66)	
(66)m	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												113.9999 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												1372.2475 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												63.4182 (69)	
Pumps, fans												3.0000 (70)	
Losses e.g. evaporation (negative values) (Table 5)												-162.3896 (71)	
Water heating gains (Table 5)												187.6971 (72)	
Total internal gains												1821.5575 (73)	

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
	m2	Table 6a	Specific data	Specific data	Factor	W
		W/m2	or Table 6b	or Table 6c	Table 6d	
North	7.5200	14.1962	0.8500	0.7000	0.7700	44.0191 (74)
East	11.7200	26.5726	0.8500	0.7000	0.7700	128.4141 (76)
Southeast	6.3500	47.2368	0.8500	0.7000	0.7700	123.6814 (77)
South	10.5500	59.2009	0.8500	0.7000	0.7700	257.5318 (78)
Southwest	6.0300	47.2368	0.8500	0.7000	0.7700	117.4487 (79)
West	17.6200	26.5726	0.8500	0.7000	0.7700	193.0594 (80)
Northwest	6.7300	15.4538	0.8500	0.7000	0.7700	42.8845 (81)
North	29.6600	14.1962	0.6300	0.7000	0.7700	128.6815 (74)
Northeast	4.2100	15.4538	0.6300	0.7000	0.7700	19.8833 (75)
East	12.4200	26.5726	0.6300	0.7000	0.7700	100.8621 (76)
Southeast	13.6800	47.2368	0.6300	0.7000	0.7700	197.4870 (77)
South	36.0500	59.2009	0.6300	0.7000	0.7700	652.2368 (78)
Southwest	4.2100	47.2368	0.6300	0.7000	0.7700	60.7763 (79)
West	15.9300	26.5726	0.6300	0.7000	0.7700	129.3667 (80)
Northwest	4.2100	15.4538	0.6300	0.7000	0.7700	19.8833 (81)
North	10.1400	36.0000	0.6300	0.7000	1.0000	144.8844 (82)
South	47.7100	36.0000	0.6300	0.7000	1.0000	681.6996 (82)

Solar gains	3042.7999	4753.6194	7352.2461	10471.5929	12068.4950	13194.1448	11621.5947	10706.6126	8619.5749	5582.9365	3593.0335	2451.9630 (83)
Total gains	4864.3573	6573.5918	9111.6764	12122.2685	13599.3746	14616.1870	12981.4851	12069.1188	10041.6696	7113.2447	5247.3724	4214.5806 (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	4.5902	4.7283	4.7283	4.9517	4.9517	5.1955	5.1955	5.2365	5.0715	4.8005	4.7641	4.6239
alpha	1.3060	1.3152	1.3152	1.3301	1.3301	1.3464	1.3464	1.3491	1.3381	1.3200	1.3176	1.3083
util living area	0.9490	0.9242	0.8805	0.8076	0.7291	0.6132	0.5606	0.5738	0.7133	0.8603	0.9265	0.9558 (86)
MIT	15.5313	15.9029	16.6335	17.7101	18.7865	19.7750	20.1985	20.1931	19.5022	18.1371	16.8007	15.5808 (87)
Th 2	18.8088	18.8531	18.8531	18.9218	18.9218	18.9927	18.9927	19.0042	18.9572	18.8757	18.8644	18.8197 (88)
util rest of house	0.9384	0.9091	0.8561	0.7679	0.6639	0.5072	0.4061	0.4154	0.6115	0.8170	0.9079	0.9464 (89)
MIT 2	13.3034	13.7576	14.6157	15.8893	17.1128	18.2013	18.6260	18.6398	17.9614	16.4187	14.8427	13.3687 (90)
Living area fraction									FLA = Living area / (4) =			0.2034 (91)
MIT	13.7566	14.1940	15.0262	16.2597	17.4532	18.5214	18.9459	18.9557	18.2748	16.7682	15.2410	13.8186 (92)
Temperature adjustment												0.0000
adjusted MIT	13.7566	14.1940	15.0262	16.2597	17.4532	18.5214	18.9459	18.9557	18.2748	16.7682	15.2410	13.8186 (93)

Energy Saving Calculation Summary



8. Space heating requirement

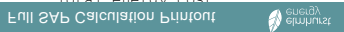
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8902	0.8484	0.7828	0.6914	0.5996	0.4752	0.4015	0.4105	0.5631	0.7442	0.8482	0.9025 (94)
Useful gains	4330.0689	5577.2191	7132.9343	8381.6805	8154.5997	6946.1662	5211.9308	4954.0072	5654.9258	5293.5417	4450.7941	3803.8268 (95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000 (96)
Heat loss rate W	22389.4310	22125.6049	21365.3579	18865.5852	15053.1916	10389.2582	7093.9521	6807.4844	9725.9464	13891.7170	17583.6444	21535.1969 (97)
Space heating kWh	13436.1653	11120.5152	10588.9231	7548.4114	5132.5524	0.0000	0.0000	0.0000	0.0000	6397.0424	9455.6522	13192.1394 (98a)
Space heating requirement - total per year (kWh/year)												76871.4015
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	13436.1653	11120.5152	10588.9231	7548.4114	5132.5524	0.0000	0.0000	0.0000	0.0000	6397.0424	9455.6522	13192.1394 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												76871.4015
Space heating per m2												(98c) / (4) = 75.8325 (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 %)													249.9000 (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	13436.1653	11120.5152	10588.9231	7548.4114	5132.5524	0.0000	0.0000	0.0000	0.0000	6397.0424	9455.6522	13192.1394 (98)	
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)	
Space heating fuel (main heating system)	5376.6168	4449.9861	4237.2642	3020.5728	2053.8425	0.0000	0.0000	0.0000	0.0000	2559.8409	3783.7744	5278.9673 (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	325.1823	287.4912	305.4277	268.8137	260.7121	235.0918	232.2481	241.4427	244.0405	271.9050	288.8155	321.6893 (64)	
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)	
Fuel for water heating, kWh/month	185.7123	164.1869	174.4304	153.5201	148.8933	134.2615	132.6374	137.8885	139.3721	155.2856	164.9432	183.7175 (219)	
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)	
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)	
Lighting	99.7835	80.0500	72.0761	52.8061	40.7889	33.3249	37.2090	48.3657	62.8223	82.4262	93.1002	102.5567 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)	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)	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)	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)	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)	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)	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)	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)	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													30760.8649 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													175.1000
Water heating fuel used													1874.8487 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year													0.0000 (231)
Electricity for lighting (calculated in Appendix L)													805.3097 (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													33441.0233 (238)

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 10a. Fuel costs - using BEDF prices (535)  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	30760.8649	25.1600	7739.4336 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1874.8487	25.1600	471.7119 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	805.3097	25.1600	202.6159 (250)
Additional standing charges			0.0000 (251)
Total energy cost			8413.7615 (255)



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 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	30760.8649	0.1534	4719.6968 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1874.8487	0.1409	264.0884 (264)
Space and water heating			4983.7852 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	805.3097	0.1443	116.2311 (268)
Total CO2, kg/year			5100.0163 (272)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	30760.8649	1.5680	48234.3231 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1874.8487	1.5208	2851.3478 (278)
Space and water heating			51085.6709 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	805.3097	1.5338	1235.2109 (282)
Total Primary energy kWh/year			52320.8817 (286)

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 SAP 10 EPC IMPROVEMENTS  
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Main House-ASHP

Current energy efficiency rating: D 67  
 Current environmental impact rating: A 93

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 1.2	-£ 356	-190 kg (3.7%)
V2 Wind turbine	+ 2.3	-£ 630	-347 kg (7.1%)
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.3	-£ 105	-53 kg (1.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar photovoltaic panels	£356	0.19 kg/m <sup>2</sup>	D 68 A 93
Wind turbine	£630	0.34 kg/m <sup>2</sup>	C 71 A 94
Total Savings	£986	0.53 kg/m <sup>2</sup>	

Potential energy efficiency rating: C 71  
 Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

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 Typical heating and lighting costs of this home (per year, South West England):  
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	Current	Potential	Saving
Electricity	£8414	£8414	£0
Space heating	£7739	£7739	£0
Water heating	£472	£472	£0
Lighting	£203	£203	£0
Generated (PV)	-£0	-£356	£356
Generated (wind)	-£0	-£630	£630
Total cost of fuels	£8414	£7428	£986
Total cost of uses	£8414	£7428	£986
Delivered energy	33 kWh/m <sup>2</sup>	29 kWh/m <sup>2</sup>	4 kWh/m <sup>2</sup>
Carbon dioxide emissions	5.1 tonnes	4.6 tonnes	0.5 tonnes
CO2 emissions per m <sup>2</sup>	5 kg/m <sup>2</sup>	5 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	52 kWh/m <sup>2</sup>	46 kWh/m <sup>2</sup>	6 kWh/m <sup>2</sup>

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SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)  
 CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Basement floor	93.7000 (1a)	x 2.1000 (2a)	= 196.7700 (1a) - (3a)
Ground floor	469.1000 (1b)	x 3.1400 (2b)	= 1472.9740 (1b) - (3b)
First floor	307.5000 (1c)	x 3.1400 (2c)	= 965.5500 (1c) - (3c)
Second floor	99.2000 (1d)	x 2.3000 (2d)	= 228.1600 (1d) - (3d)
Total floor area (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	1013.7000		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 2973.9540 (5)
Dwelling volume			

2. Ventilation rate

		m <sup>3</sup> 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	2 * 10 =	20.0000 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	60.0000 / (5) =	0.0202 (8)
Number of storeys in the dwelling (ns)		5 (9)
Additional infiltration	[(9) - 1] x 0.1 =	0.4000 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000 (12)
If no draught lobby, enter 0.05, else enter 0		0.0500 (13)
Percentage of windows and doors draught stripped		100.0000 (14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500 (15)
Pressure test		No
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.8702 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8702 (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 infltr rate												
Effective ac	1.1095	1.0877	1.0660	0.9572	0.9354	0.8267	0.8267	0.8049	0.8702	0.9354	0.9789	1.0225 (22b)
	1.1095	1.0877	1.0660	0.9581	0.9375	0.8417	0.8417	0.8239	0.8786	0.9375	0.9792	1.0225 (25)

3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window-Existing (Uw = 4.80)			66.5200	4.0268	267.8658		(27)
Window-New (Uw = 1.56)			120.3700	1.4684	176.7481		(27)
Door-Glazing			6.7200	1.6000	10.7520		(26a)
Door			6.7200	1.4000	9.4080		(26)
PR-9-S-Skylight for AB			2.5400	1.5038	3.8195		(27a)
PR-8-N-Skylight for AB			2.5400	1.5038	3.8195		(27a)
FR-1-N-Skylight for MH			5.0600	1.5038	7.6090		(27a)
FR-3-S-Skylight for MH			37.5700	1.5038	56.4962		(27a)
PR9-S-Skyroof for AB			2.5400	1.5038	3.8195		(27a)
PR8-N-Skyroof for AB			2.5400	1.5038	3.8195		(27a)
FR3-S-Skyroof			5.0600	1.5038	7.6090		(27a)
Heatloss Floor 1			93.7000	0.1200	11.2440	75.0000	7027.5000 (28)
Heatloss Floor 2			375.4000	0.2500	93.8500	110.0000	41294.0000 (28a)
BF-Wall Existing	81.1100	1.8000	79.3100	0.3100	24.5861	0.0000	0.0000 (29a)
GF-Wall Existing	163.9400	42.1000	121.8400	1.0200	124.2768	0.0000	0.0000 (29a)
1F-Wall Existing	100.3100	17.7600	82.5500	1.0200	84.2010	0.0000	0.0000 (29a)
2F-Wall Existing	92.0200	15.5400	76.4800	1.0200	78.0096	0.0000	0.0000 (29a)
3F-Wall Existing	61.4200	54.5600	6.8600	1.6000	10.9760	0.0000	0.0000 (29a)
GF-Wall Improved AB	197.7200	44.8400	152.8800	0.5000	76.4400	0.0000	0.0000 (29a)
1F-Wall Improved AB	217.7500	17.9800	199.7700	0.5000	99.8850	0.0000	0.0000 (29a)
GF-Wall New Build	68.7700	5.7500	63.0200	0.1800	11.3436	0.0000	0.0000 (29a)
Pitch Roof-1	19.2000		19.2000	0.1600	3.0720	0.0000	0.0000 (30)
Pitch Roof-2	19.2000		19.2000	0.1600	3.0720	0.0000	0.0000 (30)
Pitch Roof-3	31.1000		31.1000	0.1600	4.9760	0.0000	0.0000 (30)
Pitch Roof-4	33.0000		33.0000	0.1600	5.2800	0.0000	0.0000 (30)
Flat Roof-1	36.3000	5.0600	31.2400	0.1600	4.9984	0.0000	0.0000 (30)
Pitch Roof-5	11.4000		11.4000	0.1300	1.4820	0.0000	0.0000 (30)
Pitch Roof-6	12.1000		12.1000	0.1300	1.5730	0.0000	0.0000 (30)
Pitch Roof-7	11.4000		11.4000	0.1300	1.4820	0.0000	0.0000 (30)
Pitch Roof-8	131.3000	2.5400	128.7600	0.1300	16.7388	0.0000	0.0000 (30)
Pitch Roof-9	128.9000	7.6200	121.2800	0.1300	15.7664	0.0000	0.0000 (30)
Flat Roof-2	88.6000		88.6000	0.1600	14.1760	0.0000	0.0000 (30)
Flat Roof-3	44.2000		44.2000	0.1600	7.0720	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			2018.8400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	1239.4463		(33)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	48321.5000		(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K					47.6684		(35)

Thermal bridges (Default value 0.200 \* total exposed area) 403.7680 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 1643.2143 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)  
 (39)m Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (38)  
 Heat transfer coeff 1088.8425 1067.4926 1046.1428 940.2927 920.0890 826.0373 826.0373 808.6203 862.2646 920.0890 960.9609 1003.4431 (38)  
 Average = Sum(39)m / 12 = 2732.0567 2710.7069 2689.3570 2583.5070 2563.3033 2469.2516 2469.2516 2451.8346 2505.4789 2563.3033 2604.1751 2646.6573 (39)  
 2582.4069

HLP Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (40)  
 HLP (average) 2.6951 2.6741 2.6530 2.5486 2.5287 2.4359 2.4359 2.4187 2.4716 2.5287 2.5690 2.6109 (40)  
 Days in mont 31 28 31 30 31 30 31 31 30 31 30 31



4. Water heating energy requirements (kWh/year)

Assumed occupancy 4.0597 (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 106.5418 104.9595 102.7313 98.6229 95.5465 92.1354 90.2928 92.5055 94.9146 98.5646 102.7577 106.1816 (42b)  
 Hot water usage for other uses 56.2058 54.1620 52.1181 50.0743 48.0304 45.9866 45.9866 48.0304 50.0743 52.1181 54.1620 56.2058 (42c)  
 Average daily hot water use (litres/day) 149.8772 (43)

Daily hot water use Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (44)  
 162.7476 159.1214 154.8494 148.6971 143.5769 138.1219 136.2794 140.5359 144.9888 150.6827 156.9196 162.3874 (44)  
 Energy content (annual) 257.7523 226.5868 237.9977 203.5589 193.2822 169.8370 164.8181 174.0128 178.7857 204.4751 223.5607 254.2594 (45)  
 Distribution loss (46)m = 0.15 x (45)m Total = Sum(45)m = 2488.9267  
 38.6629 33.9880 35.6997 30.5338 28.9923 25.4756 24.7227 26.1019 26.8179 30.6713 33.5341 38.1389 (46)

Water storage loss:  
 Store volume 300.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day): 1.8000 (48)  
 Temperature factor from Table 2b 0.5400 (49)  
 Enter (49) or (54) in (55) 0.9720 (55)

Total storage loss 30.1320 27.2160 30.1320 29.1600 30.1320 29.1600 30.1320 30.1320 29.1600 30.1320 29.1600 30.1320 (56)  
 If cylinder contains dedicated solar storage 30.1320 27.2160 30.1320 29.1600 30.1320 29.1600 30.1320 30.1320 29.1600 30.1320 29.1600 30.1320 (57)  
 Primary loss 37.2980 33.6885 37.2980 36.0948 37.2980 36.0948 37.2980 37.2980 36.0948 37.2980 36.0948 37.2980 (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 325.1823 287.4912 305.4277 268.8137 260.7121 235.0918 232.2481 241.4427 244.0405 271.9050 288.8155 321.6893 (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 325.1823 287.4912 305.4277 268.8137 260.7121 235.0918 232.2481 241.4427 244.0405 271.9050 288.8155 321.6893 (64)  
 Total per year (kWh/year) = Sum(64)m = 3282.8601 (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 139.6466 124.0637 133.0782 119.8872 118.2103 108.6747 108.7460 111.8032 111.6501 121.9319 126.5378 138.4852 (65)

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

Metabolic gains (Table 5), Watts (66)m Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)  
 243.5844 243.5844 243.5844 243.5844 243.5844 243.5844 243.5844 243.5844 243.5844 243.5844 243.5844 243.5844 (66)  
 Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 113.9999 101.2537 82.3451 62.3405 46.6003 39.3419 42.5103 55.2565 74.1652 94.1697 109.9100 117.1683 (67)  
 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 1372.2475 1386.4871 1350.6037 1274.2121 1177.7815 1087.1503 1026.6031 1012.3635 1048.2469 1124.6385 1221.0691 1311.7003 (68)  
 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 63.4182 63.4182 63.4182 63.4182 63.4182 63.4182 63.4182 63.4182 63.4182 63.4182 63.4182 63.4182 (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) -162.3896 -162.3896 -162.3896 -162.3896 -162.3896 -162.3896 -162.3896 -162.3896 -162.3896 -162.3896 -162.3896 -162.3896 (71)  
 Water heating gains (Table 5) 187.6971 184.6186 178.8686 166.5100 158.8848 150.9370 146.1640 150.2731 155.0696 163.8870 175.7469 186.1360 (72)  
 Total internal gains 1821.5575 1819.9724 1759.4303 1650.6756 1530.8796 1422.0422 1359.8904 1362.5061 1422.0947 1530.3082 1654.3390 1762.6176 (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	7.5200	10.6334	0.8500	0.7000	0.7700	32.9716 (74)
East	11.7200	19.6403	0.8500	0.7000	0.7700	94.9129 (76)
Southeast	6.3500	36.7938	0.8500	0.7000	0.7700	96.3383 (77)
South	10.5500	46.7521	0.8500	0.7000	0.7700	203.3778 (78)
Southwest	6.0300	36.7938	0.8500	0.7000	0.7700	91.4835 (79)
West	17.6200	19.6403	0.8500	0.7000	0.7700	142.6932 (80)
Northwest	6.7300	11.2829	0.8500	0.7000	0.7700	31.3103 (81)
North	29.6600	10.6334	0.6300	0.7000	0.7700	96.3862 (74)
Northeast	4.2100	11.2829	0.6300	0.7000	0.7700	14.5170 (75)
East	12.4200	19.6403	0.6300	0.7000	0.7700	74.5488 (76)
Southeast	13.6800	36.7938	0.6300	0.7000	0.7700	153.8271 (77)
South	36.0500	46.7521	0.6300	0.7000	0.7700	515.0838 (78)
Southwest	4.2100	36.7938	0.6300	0.7000	0.7700	47.3401 (79)
West	15.9300	19.6403	0.6300	0.7000	0.7700	95.6170 (80)
Northwest	4.2100	11.2829	0.6300	0.7000	0.7700	14.5170 (81)
North	10.1400	26.0000	0.6300	0.7000	1.0000	104.6387 (82)

South	47.7100	26.0000	0.6300	0.7000	1.0000	492.3386 (82)						
Solar gains	2301.9018	4246.8531	6564.7142	9215.5388	11177.4364	11437.5840	10887.7485	9395.2567	7490.4303	4907.7479	2819.1948	1928.3353 (83)
Total gains	4123.4592	6066.8255	8324.1444	10866.2144	12708.3160	12859.6263	12247.6389	10757.7628	8912.5250	6438.0561	4473.5338	3690.9530 (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	4.9130	4.9517	4.9910	5.1955	5.2365	5.4359	5.4359	5.4745	5.3573	5.2365	5.1543	5.0715
alpha	1.3275	1.3301	1.3327	1.3464	1.3491	1.3624	1.3624	1.3650	1.3572	1.3491	1.3436	1.3381
MIT	0.9557	0.9258	0.8775	0.7941	0.6813	0.5316	0.3770	0.4334	0.6672	0.8540	0.9357	0.9613 (89)
MIT 2	14.7919	15.3042	16.2359	17.5173	18.7284	19.7578	20.3123	20.1942	19.2972	17.6975	16.0336	14.7344 (87)
Th 2	18.9102	18.9218	18.9335	18.9927	19.0042	19.0586	19.0586	19.0688	19.0375	19.0042	18.9810	18.9572 (88)
util rest of house	0.9557	0.9258	0.8775	0.7941	0.6813	0.5316	0.3770	0.4334	0.6672	0.8540	0.9357	0.9613 (89)
MIT 2	12.4516	13.0654	14.1751	15.7004	17.0915	18.2389	18.7730	18.6970	17.7917	15.9552	13.9677	12.3986 (90)
Living area fraction	12.9276	13.5208	14.5943	16.0700	17.4245	18.5478	19.0861	19.0016	18.0979	16.3096	14.3879	12.8738 (92)
MIT	12.9276	13.5208	14.5943	16.0700	17.4245	18.5478	19.0861	19.0016	18.0979	16.3096	14.3879	12.8738 (92)
Temperature adjustment	12.9276	13.5208	14.5943	16.0700	17.4245	18.5478	19.0861	19.0016	18.0979	16.3096	14.3879	12.8738 (93)
adjusted MIT	12.9276	13.5208	14.5943	16.0700	17.4245	18.5478	19.0861	19.0016	18.0979	16.3096	14.3879	12.8738 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9170	0.8713	0.8081	0.7176	0.6152	0.4962	0.3799	0.4263	0.6091	0.7836	0.8865	0.9262 (94)
Ext temp.	3781.3053	5285.9439	6726.7668	7797.9535	7817.5661	6380.8444	4653.4623	4585.5125	5428.6064	5044.7618	3965.8861	3418.7040 (95)
Heat loss rate W	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)
Space heating kWh	23571.1587	23368.4087	21768.4672	18523.7329	14673.5176	9748.1620	6138.8855	6378.6275	10016.7261	14635.3766	18979.0167	22956.4999 (97)
Space heating requirement - total per year (kWh/year)	14723.6509	12151.4163	11191.0251	7722.5612	5100.8279	0.0000	0.0000	0.0000	0.0000	7135.4174	10809.4541	14536.1201 (98a)
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)
Space heating requirement after solar contribution - total per year (kWh/year)	14723.6509	12151.4163	11191.0251	7722.5612	5100.8279	0.0000	0.0000	0.0000	0.0000	7135.4174	10809.4541	14536.1201 (98c)
Space heating per m2												82.2437 (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 %)												249.9000 (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	14723.6509	12151.4163	11191.0251	7722.5612	5100.8279	0.0000	0.0000	0.0000	0.0000	7135.4174	10809.4541	14536.1201 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system 1)	5891.8171	4862.5115	4478.2013	3090.2606	2041.1476	0.0000	0.0000	0.0000	0.0000	2855.3091	4325.5118	5816.7748 (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	325.1823	287.4912	305.4277	268.8137	260.7121	235.0918	232.2481	241.4427	244.0405	271.9050	288.8155	321.6893 (64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	185.7123	164.1869	174.4304	153.5201	148.8933	134.2615	132.6374	137.8885	139.3721	155.2856	164.9432	183.7175 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	99.7835	80.0500	72.0761	52.8061	40.7889	33.3249	37.2090	48.3657	62.8223	82.4262	93.1002	102.5567 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-46.1893	-74.4928	-121.8879	-154.5271	-179.1924	-141.3972	-139.4117	-126.0694	-104.5942	-90.8355	-53.6635	-38.9013 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	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)	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)	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)	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)	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)	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												33361.5338 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												175.1000
Water heating fuel used												1874.8487 (219)
Space cooling fuel												0.0000 (221)



Electricity for pumps and fans:  
 Total electricity for the above, kWh/year 0.0000 (231)  
 Electricity for lighting (calculated in Appendix L) 805.3097 (232)

Energy saving/generation technologies (Appendices M ,N and Q)  
 PV generation -1271.1621 (233)  
 Wind generation -3575.5408 (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 32267.6515 (238)

**Επιμέτρηση Εξοικονομώ Έξυπνα**

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 Total fuel costs using Table 12 prices  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	33361.5338	16.4900	5501.3169 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1874.8487	16.4900	309.1626 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	805.3097	16.4900	132.7956 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1271.1621	16.4900	-209.6146
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-209.6146 (252)
Wind Turbine electricity used in dwelling	-2502.8785	16.4900	-412.7247
Wind Turbine electricity exported	0.0000	5.5900	0.0000
Total			-412.7247 (252)
Total energy cost			5320.9357 (255)

11a. SAP rating - Individual heating systems

-----  
 Energy cost deflator (Table 12): 0.3600 (256)  
 Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.8093 (257)  
 SAP value 70.6708  
 SAP rating (Section 12) 71 (258)  
 SAP band C  
 -----

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	33361.5338	0.1536	5124.4802 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1874.8487	0.1409	264.0884 (264)
Space and water heating			5388.5686 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	805.3097	0.1443	116.2311 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1271.1621	0.1337	-169.9677
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-169.9677 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-347.1801 (269)
Total CO2, kg/year			4987.6519 (272)
CO2 emissions per m2			4.9200 (273)
EI value			93.6871
EI rating			94 (274)
EI band			A -----

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

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	Area (m2)	Storey height (m)	Volume (m3)
Basement floor	93.7000 (1a)	x 2.1000 (2a)	= 196.7700 (1a) - (3a)
Ground floor	469.1000 (1b)	x 3.1400 (2b)	= 1472.9740 (1b) - (3b)
First floor	307.5000 (1c)	x 3.1400 (2c)	= 965.5500 (1c) - (3c)
Second floor	99.2000 (1d)	x 2.3000 (2d)	= 228.1600 (1d) - (3d)
Third floor	44.2000 (1e)	x 2.5000 (2e)	= 110.5000 (1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	1013.7000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	2973.9540 (5)

2. Ventilation rate

m3 per hour



	56.2058	54.1620	52.1181	50.0743	48.0304	45.9866	45.9866	48.0304	50.0743	52.1181	54.1620	56.2058 (42c)
Average daily hot water use (litres/day)												149.8772 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	162.7476	159.1214	154.8494	148.6971	143.5769	138.1219	136.2794	140.5359	144.9888	150.6827	156.9196	162.3874 (44)
Energy content (annual)	257.7523	226.5868	237.9977	203.5589	193.2822	169.8370	164.8181	174.0128	178.7857	204.4751	223.5607	254.2594 (45)
Distribution loss (46)m = 0.15 x (45)m	38.6629	33.9880	35.6997	30.5338	28.9923	25.4756	24.7227	26.1019	26.8179	30.6713	33.5341	38.1389 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9720 (55)
Total storage loss												
11 Cylinder contains domestic solar storage	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320 (56)
Primary loss	37.2980	33.6885	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	36.0948	37.2980	36.0948	37.2980 (57)
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	325.1823	287.4912	305.4277	268.8137	260.7121	235.0918	232.2481	241.4427	244.0405	271.9050	288.8155	321.6893 (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	325.1823	287.4912	305.4277	268.8137	260.7121	235.0918	232.2481	241.4427	244.0405	271.9050	288.8155	321.6893 (64)
												Total per year (kWh/year) = Sum(64)m = 3282.8601 (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	139.6466	124.0637	133.0782	119.8872	118.2103	108.6747	108.7460	111.8032	111.6501	121.9319	126.5378	138.4852 (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	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844	243.5844 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	113.9999	101.2537	82.3451	62.3405	46.6003	39.3419	42.5103	55.2565	74.1652	94.1697	109.9100	117.1683 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	1372.2475	1386.4871	1350.6037	1274.2121	1177.7815	1087.1503	1026.6031	1012.3635	1048.2469	1124.6385	1221.0691	1311.7003 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	63.4182	63.4182	63.4182	63.4182	63.4182	63.4182	63.4182	63.4182	63.4182	63.4182	63.4182	63.4182 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-162.3896	-162.3896	-162.3896	-162.3896	-162.3896	-162.3896	-162.3896	-162.3896	-162.3896	-162.3896	-162.3896	-162.3896 (71)
Water heating gains (Table 5)	187.6971	184.6186	178.8686	166.5100	158.8848	150.9370	146.1640	150.2731	155.0696	163.8870	175.7469	186.1360 (72)
Total internal gains	1821.5575	1819.9724	1759.4303	1650.6756	1530.8796	1422.0422	1359.8904	1362.5061	1422.0947	1530.3082	1654.3390	1762.6176 (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	7.5200	14.1962	0.8500	0.7000	0.7700	44.0191 (74)
East	11.7200	26.5726	0.8500	0.7000	0.7700	128.4141 (76)
Southeast	6.3500	47.2368	0.8500	0.7000	0.7700	123.6814 (77)
South	10.5500	59.2009	0.8500	0.7000	0.7700	257.5318 (78)
Southwest	6.0300	47.2368	0.8500	0.7000	0.7700	117.4487 (79)
West	17.6200	26.5726	0.8500	0.7000	0.7700	193.0594 (80)
Northwest	6.7300	15.4538	0.8500	0.7000	0.7700	42.8845 (81)
North	29.6600	14.1962	0.6300	0.7000	0.7700	128.6815 (74)
Northeast	4.2100	15.4538	0.6300	0.7000	0.7700	19.8833 (75)
East	12.4200	26.5726	0.6300	0.7000	0.7700	100.8621 (76)
Southeast	13.6800	47.2368	0.6300	0.7000	0.7700	197.4870 (77)
South	36.0500	59.2009	0.6300	0.7000	0.7700	652.2368 (78)
Southwest	4.2100	47.2368	0.6300	0.7000	0.7700	60.7763 (79)
West	15.9300	26.5726	0.6300	0.7000	0.7700	129.3667 (80)
Northwest	4.2100	15.4538	0.6300	0.7000	0.7700	19.8833 (81)
North	10.1400	36.0000	0.6300	0.7000	1.0000	144.8844 (82)
South	47.7100	36.0000	0.6300	0.7000	1.0000	681.6996 (82)

Solar gains	3042.7999	4753.6194	7352.2461	10471.5929	12068.4950	13194.1448	11621.5947	10706.6126	8619.5749	5582.9365	3593.0335	2451.9630 (83)
Total gains	4864.3573	6573.5918	9111.6764	12122.2685	13599.3746	14616.1870	12981.4851	12069.1188	10041.6696	7113.2447	5247.3724	4214.5806 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	4.5902	4.7283	4.7283	4.9517	4.9517	5.1955	5.1955	5.2365	5.0715	4.8005	4.7641	4.6239
alpha	1.3060	1.3152	1.3152	1.3301	1.3301	1.3464	1.3464	1.3491	1.3381	1.3200	1.3176	1.3083
util living area	0.9490	0.9242	0.8805	0.8076	0.7291	0.6132	0.5606	0.5738	0.7133	0.8603	0.9265	0.9558 (86)
MIT	15.5313	15.9029	16.6335	17.7101	18.7865	19.7750	20.1985	20.1931	19.5022	18.1371	16.8007	15.5808 (87)
Th 2	18.8088	18.8531	18.8531	18.9218	18.9218	18.9927	18.9927	19.0042	18.9572	18.8757	18.8644	18.8197 (88)
util rest of house	0.9384	0.9091	0.8561	0.7679	0.6639	0.5072	0.4061	0.4154	0.6115	0.8170	0.9079	0.9464 (89)
MIT 2	13.3034	13.7576	14.6157	15.8893	17.1128	18.2013	18.6260	18.6398	17.9614	16.4187	14.8427	13.3687 (90)
Living area fraction												0.2034 (91)
MIT	13.7566	14.1940	15.0262	16.2597	17.4532	18.5214	18.9459	18.9557	18.2748	16.7682	15.2410	13.8186 (92)
Temperature adjustment												0.0000
adjusted MIT	13.7566	14.1940	15.0262	16.2597	17.4532	18.5214	18.9459	18.9557	18.2748	16.7682	15.2410	13.8186 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8902	0.8484	0.7828	0.6914	0.5996	0.4752	0.4015	0.4105	0.5631	0.7442	0.8482	0.9025	(94)
Useful gains	4330.0689	5577.2191	7132.9343	8381.6805	8154.5997	6946.1662	5211.9308	4954.0072	5654.9258	5293.5417	4450.7941	3803.8268	(95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000	(96)
Heat loss rate W	22389.4310	22125.6049	21365.3579	18865.5852	15053.1916	10389.2582	7093.9521	6807.4844	9725.9464	13891.7170	17583.6444	21535.1969	(97)
Space heating kWh	13436.1653	11120.5152	10588.9231	7548.4114	5132.5524	0.0000	0.0000	0.0000	0.0000	6397.0424	9455.6522	13192.1394	(98a)
Space heating requirement - total per year (kWh/year)												76871.4015	
Solar heating contribution - total per year (kWh/year)			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating kWh	13436.1653	11120.5152	10588.9231	7548.4114	5132.5524	0.0000	0.0000	0.0000	0.0000	6397.0424	9455.6522	13192.1394	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												76871.4015	
Space heating per m2												75.8325	(99)

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

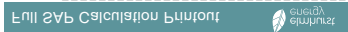
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													249.9000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement	13436.1653	11120.5152	10588.9231	7548.4114	5132.5524	0.0000	0.0000	0.0000	0.0000	6397.0424	9455.6522	13192.1394	(98)	
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)	
Space heating fuel (main heating system)	5376.6168	4449.9861	4237.2642	3020.5728	2053.8425	0.0000	0.0000	0.0000	0.0000	2559.8409	3783.7744	5278.9673	(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	325.1823	287.4912	305.4277	268.8137	260.7121	235.0918	232.2481	241.4427	244.0405	271.9050	288.8155	321.6893	(64)	
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)	
Fuel for water heating, kWh/month	185.7123	164.1869	174.4304	153.5201	148.8933	134.2615	132.6374	137.8885	139.3721	155.2856	164.9432	183.7175	(219)	
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)	
Lighting	99.7835	80.0500	72.0761	52.8061	40.7889	33.3249	37.2090	48.3657	62.8223	82.4262	93.1002	102.5567	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-60.1408	-82.4064	-134.4237	-172.0821	-190.6603	-156.5623	-145.7948	-138.6625	-116.4803	-101.3574	-67.0944	-48.8776	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	(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													30760.8649	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.1000	
Water heating fuel used													1874.8487	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
Total electricity for the above, kWh/year													0.0000	(231)
Electricity for lighting (calculated in Appendix L)													805.3097	(232)
Energy saving/generation technologies (Appendices M, N and Q)														
PV generation													-1414.5427	(233)
Wind generation													-3575.5408	(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													29523.6021	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	30760.8649	25.1600	7739.4336	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1874.8487	25.1600	471.7119	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	805.3097	25.1600	202.6159	(250)
Additional standing charges			0.0000	(251)

Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1414.5427	25.1600	-355.8989
PV Unit electricity exported	0.0000	5.8100	0.0000
Total			-355.8989 (252)
Wind Turbine electricity used in dwelling	-2502.8785	25.1600	-629.7242
Wind Turbine electricity exported	0.0000	5.8100	0.0000
Total			-629.7242 (252)
Total energy cost			7428.1383 (255)

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 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	30760.8649	0.1534	4719.6968 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1874.8487	0.1409	264.0884 (264)
Space and water heating			4983.7852 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	805.3097	0.1443	116.2311 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1414.5427	0.1343	-189.9241
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-189.9241 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-347.1801 (269)
Total CO2, kg/year			4562.9121 (272)

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 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	30760.8649	1.5680	48234.3231 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1874.8487	1.5208	2851.3478 (278)
Space and water heating			51085.6709 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	805.3097	1.5338	1235.2109 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1414.5427	1.4962	-2116.4542
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-2116.4542 (283)
Wind Turbine electricity used in dwelling	-2502.8785	1.5128	-3786.3546
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-3786.3546 (283)
Total Primary energy kWh/year			46418.0729 (286)

Property Reference	2324 Red Brick Barn		Issued on Date	23/01/2024
Assessment Reference	Red Brick Barn-ASHP_Improved	Prop Type Ref		
Property				
SAP Rating	36 F	DER		TER
Environmental	86 B	% DER < TER		N/A
CO <sub>2</sub> Emissions (t/year)	1.13	DFEE		TFEE
Compliance Check	See BREL	% DFEE < TFEE		
% DPER < TPER		DPER		TPER
Client	Mr. Abdul Mohammed		Assessor ID	K333-0001

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING

1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	50.9000 (1b)	2.1800 (2b)	110.9620 (1b) - (3b)
First floor	18.4000 (1c)	4.9600 (2c)	91.2640 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	69.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	202.2260 (5)

2. Ventilation rate

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.0989 (8)
Number of storeys in the dwelling (ns)	5 (9)
Additional infiltration	[(9) - 1] x 0.1 = 0.4000 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0.3500 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0.0000 (12)
If no draught lobby, enter 0.05, else enter 0	0.0500 (13)
Percentage of windows and doors draught stripped	100.0000 (14)
Window infiltration	0.25 - [0.2 * (14) / 100] = 0.0500 (15)
Pressure test	No
Pressure Test Method	Blower Door
Measured/design AP50	15.0000 (17)
Infiltration rate	0.9489 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.9489 (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	1.2098	1.1861	1.1624	1.0438	1.0201	0.9015	0.9015	0.8777	0.9489	1.0201	1.0675	1.1150 (22b)
Effective ac	1.2098	1.1861	1.1624	1.0438	1.0201	0.9063	0.9063	0.8852	0.9502	1.0201	1.0675	1.1150 (25)

3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window-New (Uw = 1.56)			17.2700	1.4684	25.3588		(27)
Door			4.3100	2.0000	8.6200		(26)
Heatloss Floor 1			50.9000	0.2000	10.1800	110.0000	5599.0000 (28a)
GF-Wall Existing	43.6600	18.1800	25.4800	0.2400	6.1152	0.0000	0.0000 (29a)
1F-Wall Existing	119.4600	3.4000	116.0600	0.2400	27.8544	0.0000	0.0000 (29a)
GF-Wall Insulated	28.3100		28.3100	0.5000	14.1550	0.0000	0.0000 (29a)
Pitch Roof-1	24.3000		24.3000	0.1600	3.8880	0.0000	0.0000 (30)
Pitch Roof-2	24.3000		24.3000	0.1600	3.8880	0.0000	0.0000 (30)
Pitch Roof-3	9.3000		9.3000	0.1600	1.4880	0.0000	0.0000 (30)
Pitch Roof-4	9.3000		9.3000	0.1600	1.4880	0.0000	0.0000 (30)

Total net area of external elements Aum(A, m2) 309.5300 (31)  
 Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 103.0354 (33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 5599.0000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 80.7937 (35)  
 Thermal bridges (Default value 0.200 \* total exposed area) 61.9060 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 164.9414 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)  
 (38)m Jan 80.7386 Feb 79.1555 Mar 77.5724 Apr 69.6568 May 68.0737 Jun 60.4822 Jul 60.4822 Aug 59.0739 Sep 63.4115 Oct 68.0737 Nov 71.2399 Dec 74.4062 (38)  
 Heat transfer coeff 245.6800 244.0969 242.5138 234.5982 233.0151 225.4236 225.4236 224.0153 228.3529 233.0151 236.1814 239.3476 (39)  
 Average = Sum(39)m / 12 = 234.3053



HLP (average) 3.4995 3.3853 3.3624 3.2529 3.2529 3.2325 3.2951 3.3624 3.4081 3.4538 (40)  
 Days in mont 31 28 31 30 31 30 31 31 30 31 30 31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2290 (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 71.0028 69.9483 68.4633 65.7254 63.6752 61.4019 60.1740 61.6485 63.2540 65.6866 68.4809 70.7627 (42b)  
 Hot water usage for other uses 37.4573 36.0952 34.7331 33.3710 32.0090 30.6469 30.6469 32.0090 33.3710 34.7331 36.0952 37.4573 (42c)  
 Average daily hot water use (litres/day) 99.8828 (43)

Daily hot water use  
 Energy conte 108.4601 106.0435 103.1965 99.0964 95.6842 92.0488 90.8209 93.6575 96.6251 100.4197 104.5761 108.2200 (44)  
 Energy content (annual) 171.7742 151.0045 158.6091 135.6580 128.8093 113.1847 109.8399 115.9675 119.1484 136.2686 148.9879 169.4464 (45)  
 Distribution loss (46)m = 0.15 x (45)m Total = Sum(45)m = 1658.6986

Water storage loss:  
 Store volume 125.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day): 1.0500 (48)  
 Temperature factor from Table 2b 0.5400 (49)  
 Enter (49) or (54) in (55) 0.5670 (55)  
 Total storage loss

17.5770 15.8760 17.5770 17.0100 17.5770 17.0100 17.5770 17.5770 17.0100 17.5770 17.0100 17.5770 (56)  
 If cylinder contains dedicated solar storage  
 Primary loss 17.5770 15.8760 17.5770 17.0100 17.5770 17.0100 17.5770 17.5770 17.0100 17.5770 17.0100 17.5770 (57)  
 Combi loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 (59)  
 Total heat required for water heating calculated for each month

212.6136 187.8917 199.4485 175.1800 169.6487 152.7067 150.6793 156.8069 158.6704 177.1080 188.5099 210.2858 (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 212.6136 187.8917 199.4485 175.1800 169.6487 152.7067 150.6793 156.8069 158.6704 177.1080 188.5099 210.2858 (64)  
 Total per year (kWh/year) = Sum(64)m = 2139.5496 (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 89.7864 79.7188 85.4090 76.7239 75.5006 69.2515 69.1933 71.2307 71.2344 77.9808 81.1561 89.0124 (65)

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

Metabolic gains (Table 5), Watts  
 (66)m 133.7407 133.7407 133.7407 133.7407 133.7407 133.7407 133.7407 133.7407 133.7407 133.7407 133.7407 133.7407 (66)  
 Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 21.6935 19.2680 15.6698 11.8630 8.8678 7.4865 8.0895 10.5150 14.1132 17.9200 20.9152 22.2965 (67)  
 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 292.0266 295.0569 287.4206 271.1638 250.6425 231.3554 218.4704 215.4401 223.0764 239.3332 259.8545 279.1416 (68)  
 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 50.6031 50.6031 50.6031 50.6031 50.6031 50.6031 50.6031 50.6031 50.6031 50.6031 50.6031 50.6031 (69)  
 Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 0.0000 0.0000 0.0000 0.0000 3.0000 3.0000 3.0000 (70)  
 Losses e.g. evaporation (negative values) (Table 5) -89.1604 -89.1604 -89.1604 -89.1604 -89.1604 -89.1604 -89.1604 -89.1604 -89.1604 -89.1604 -89.1604 -89.1604 (71)  
 Water heating gains (Table 5) 120.6807 118.6291 114.7971 106.5610 101.4793 96.1827 93.0018 95.7402 98.9367 104.8129 112.7168 119.6404 (72)  
 Total internal gains 532.5841 531.1373 516.0708 487.7711 459.1729 430.2079 414.7449 416.8786 431.3096 460.2494 491.6698 519.2618 (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	17.2700	10.6334	0.6300	0.7000	0.7700	56.1224 (74)						
Solar gains	56.1224	107.2527	182.2486	292.7380	394.3448	422.1578	394.1383	312.6984	219.1219	127.6704	69.2342	46.7864 (83)
Total gains	588.7065	638.3900	698.3194	780.5091	853.5177	852.3657	808.8832	729.5770	650.4315	587.9197	560.9039	566.0481 (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	6.3305	6.3716	6.4132	6.6295	6.6746	6.8994	6.8994	6.9427	6.8109	6.6746	6.5851	6.4980
alpha	1.4220	1.4248	1.4275	1.4420	1.4450	1.4600	1.4600	1.4628	1.4541	1.4450	1.4390	1.4332
util living area	0.9453	0.9364	0.9187	0.8823	0.8243	0.7386	0.6528	0.6924	0.8169	0.8990	0.9339	0.9478 (86)
MIT	15.3359	15.6493	16.3585	17.4325	18.5580	19.6059	20.2048	20.0948	19.2284	17.8383	16.4470	15.3128 (87)
Th 2	18.5022	18.5116	18.5211	18.5697	18.5797	18.6289	18.6289	18.6382	18.6097	18.5797	18.5598	18.5403 (88)
util rest of house	0.9329	0.9215	0.8979	0.8479	0.7607	0.6122	0.4237	0.4813	0.7207	0.8622	0.9159	0.9361 (89)
MIT 2	12.8093	13.1876	14.0405	15.3330	16.6471	17.8237	18.3899	18.3234	17.4532	15.8393	14.1675	12.7926 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	20.3272	20.5123	20.9377	21.5799	22.3330	23.1267	23.7899	23.5940	22.7354	21.7873	20.9502	20.2914 (92)
Temperature adjustment	0.0000											
Energy saving generation features	123	20.9377	21.5799	22.3330	23.1267	23.7899	23.5940	22.7354	21.7873	20.9502	20.2914 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9424	0.9338	0.9182	0.8886	0.8482	0.8036	0.7783	0.7999	0.8570	0.9075	0.9336	0.9448 (94)
Useful gains	554.7988	596.1558	641.2152	693.5708	723.9956	685.0001	629.5469	583.5850	557.4251	533.5617	523.6550	534.8304 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.1000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	3937.5577	3810.9091	3501.3362	2974.6730	2477.6506	1922.1226	1620.7727	1611.5668	1971.9187	2606.8135	3271.1655	3851.4314 (97)
Space heating kWh	2516.7726	2160.3142	2127.9300	1642.3936	1304.7193	0.0000	0.0000	0.0000	0.0000	1542.4994	1978.2075	2467.5511 (98a)
Space heating requirement - total per year (kWh/year)												15740.3878
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	2516.7726	2160.3142	2127.9300	1642.3936	1304.7193	0.0000	0.0000	0.0000	0.0000	1542.4994	1978.2075	2467.5511 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												15740.3878
Space heating per m2												(98c) / (4) = 227.1340 (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 %)												249.9000 (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	2516.7726	2160.3142	2127.9300	1642.3936	1304.7193	0.0000	0.0000	0.0000	0.0000	1542.4994	1978.2075	2467.5511 (98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000 (210)
Space heating fuel (main heating system)	1007.1119	864.4715	851.5126	657.2203	522.0966	0.0000	0.0000	0.0000	0.0000	617.2466	791.5997	987.4154 (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	212.6136	187.8917	199.4485	175.1800	169.6487	152.7067	150.6793	156.8069	158.6704	177.1080	188.5099	210.2858 (64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000 (216)
Fuel for water heating, kWh/month	121.4241	107.3054	113.9055	100.0457	96.8867	87.2111	86.0533	89.5528	90.6170	101.1468	107.6584	120.0947 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	18.9882	15.2331	13.7157	10.0487	7.7619	6.3415	7.0807	9.2037	11.9547	15.6852	17.7164	19.5160 (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												6298.6746 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												175.1000
Water heating fuel used												1221.9015 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												153.2458 (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 7673.8220 (238)

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 10a. Fuel costs - using Table 12 prices  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	6298.6746	16.4900	1038.6514 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1221.9015	16.4900	201.4916 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	153.2458	16.4900	25.2702 (250)
Total energy cost			0.0000 (251)
			1265.4132 (255)

-----  
 11a. SAP rating - Individual heating systems  
 -----

Energy cost deflator (Table 12): 0.3600 (256)  
 Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 3.9856 (257)  
 SAP value 36.4411  
 SAP rating (Section 12) 36 (258)  
 SAP band F

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 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	6298.6746	0.1524	960.0812 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1221.9015	0.1409	172.1744 (264)
Space and water heating			1132.2555 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	153.2458	0.1443	22.1181 (268)
Total CO2, kg/year			1154.3736 (272)
CO2 emissions per m2			16.6600 (273)
EI value			86.4667
EI rating			86 (274)
EI band			B

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 SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY  
 -----

-----  
 1. Overall dwelling characteristics  
 -----

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	50.9000 (1b)	x 2.1800 (2b)	= 110.9620 (1b) - (3b)
First floor	18.4000 (1c)	x 4.9600 (2c)	= 91.2640 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	69.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 202.2260 (5)

-----  
 2. Ventilation rate  
 -----

m3 per hour

Number of open chimneys 0 \* 80 = 0.0000 (6a)  
 Number of open flues 0 \* 20 = 0.0000 (6b)  
 Number of chimneys / flues attached to closed fire 0 \* 10 = 0.0000 (6c)  
 Number of flues attached to solid fuel boiler 0 \* 20 = 0.0000 (6d)  
 Number of flues attached to other heater 0 \* 35 = 0.0000 (6e)  
 Number of blocked chimneys 0 \* 20 = 0.0000 (6f)  
 Number of intermittent extract fans 2 \* 10 = 20.0000 (7a)  
 Number of passive vents 0 \* 10 = 0.0000 (7b)  
 Number of flueless gas fires 0 \* 40 = 0.0000 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 20.0000 / (5) = 0.0989 (8)  
 Number of storeys in the dwelling (ns) 5 (9)  
 Additional infiltration [(9) - 1] x 0.1 = 0.4000 (10)  
 Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0.3500 (11)

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0.0000 (12)  
 If no draught lobby, enter 0.05, else enter 0 0.0500 (13)  
 Percentage of windows and doors draught stripped 100.0000 (14)  
 Window infiltration 0.25 - [0.2 \* (14) / 100] = 0.0500 (15)

Pressure test No  
 Pressure Test Method Blower Door  
 Measured/design AP50 15.0000 (17)  
 Infiltration rate 0.9489 (18)  
 Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.9489 (21)





(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												6124.6319	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												175.1000	
Water heating fuel used												1221.9015	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												153.2458	(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												7499.7793	(238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6124.6319	25.1600	1540.9574	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1221.9015	25.1600	307.4304	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	153.2458	25.1600	38.5567	(250)
Additional standing charges			0.0000	(251)
Total energy cost			1886.9445	(255)

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	6124.6319	0.1522	932.1751	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1221.9015	0.1409	172.1744	(264)
Space and water heating			1104.3495	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	153.2458	0.1443	22.1181	(268)
Total CO2, kg/year			1126.4676	(272)

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	6124.6319	1.5635	9575.6850	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1221.9015	1.5210	1858.5402	(278)
Space and water heating			11434.2252	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	153.2458	1.5338	235.0536	(282)
Total Primary energy kWh/year			11669.2788	(286)

SAP 10 EPC IMPROVEMENTS

Red Brick Barn-ASHP\_Improved

Current energy efficiency rating: F 36  
Current environmental impact rating: B 86

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.0	-£ 88	-44 kg (3.9%)
U Solar photovoltaic panels	+ 7.2	-£ 256	-139 kg (12.9%)
V2 Wind turbine	+ 21.1	-£ 630	-347 kg (36.8%)

Recommended measures	Typical annual savings	Energy efficiency impact	Environmental impact
Solar water heating	£88	0.64 kg/m <sup>2</sup>	F 38 B 87
Solar photovoltaic panels	£256	2.01 kg/m <sup>2</sup>	E 46 B 88
Wind turbine	£630	5.01 kg/m <sup>2</sup>	D 67 A 92
Total Savings	£974	7.66 kg/m <sup>2</sup>	

Potential energy efficiency rating: D 67  
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)

Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South West England):

	Current	Potential	Saving
Electricity	£1887	£1799	£88
Space heating	£1541	£1562	-£21
Water heating	£307	£199	£109
Lighting	£39	£39	£0
Generated (PV)	-£0	-£256	£256
Generated (wind)	-£0	-£630	£630
Total cost of fuels	£1887	£913	£974
Total cost of uses	£1887	£914	£974
Delivered energy	108 kWh/m <sup>2</sup>	52 kWh/m <sup>2</sup>	56 kWh/m <sup>2</sup>
Carbon dioxide emissions	1.1 tonnes	0.6 tonnes	0.5 tonnes
Primary energy	16 kWh/m <sup>2</sup>	9 kWh/m <sup>2</sup>	8 kWh/m <sup>2</sup>
Primary energy	168 kWh/m <sup>2</sup>	84 kWh/m <sup>2</sup>	84 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	50.9000 (1b)	x 2.1800 (2b)	= 110.9620 (1b) - (3b)
First floor	18.4000 (1c)	x 4.9600 (2c)	= 91.2640 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	69.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 202.2260 (5)

2. Ventilation rate

Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) =	0.0989 (8)
Number of storeys in the dwelling (ns)		5 (9)
Additional infiltration	[(9) - 1] x 0.1 =	0.4000 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000 (12)
If no draught lobby, enter 0.05, else enter 0		0.0500 (13)
Percentage of windows and doors draught stripped		100.0000 (14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500 (15)
Pressure test		No Blower Door
Pressure Test Method		15.0000 (17)
Measured/design AP50		0.9489 (18)
Infiltration rate		0 (19)
Number of sides sheltered		
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.9489 (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	1.2098	1.1861	1.1624	1.0438	1.0201	0.9015	0.9015	0.8777	0.9489	1.0201	1.0675	1.1150 (22b)
Effective ac	1.2098	1.1861	1.1624	1.0438	1.0201	0.9063	0.9063	0.8852	0.9502	1.0201	1.0675	1.1150 (25)

3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window-New (Uw = 1.56)			17.2700	1.4684	25.3588		(27)
Door			4.3100	2.0000	8.6200		(26)
Heatloss Floor 1			50.9000	0.2000	10.1800	110.0000	5599.0000 (28a)
GF-Wall_Existing	43.6600	18.1800	25.4800	0.2400	6.1152	0.0000	0.0000 (29a)
1F-Wall_Existing	119.4600	3.4000	116.0600	0.2400	27.8544	0.0000	0.0000 (29a)
GF-Wall1_Insulated	28.3100		28.3100	0.5000	14.1550	0.0000	0.0000 (29a)
Pitch Roof-1	24.3000		24.3000	0.1600	3.8880	0.0000	0.0000 (30)
Pitch Roof-2	24.3000		24.3000	0.1600	3.8880	0.0000	0.0000 (30)
Pitch Roof-3	9.3000		9.3000	0.1600	1.4880	0.0000	0.0000 (30)
Pitch Roof-4	9.3000		9.3000	0.1600	1.4880	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			309.5300				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.0354		(33)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				5599.0000 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 80.7937 (35)  
 Thermal bridges (Default value 0.200 \* total exposed area) 61.9060 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 164.9414 (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	80.7386	79.1555	77.5724	69.6568	68.0737	60.4822	60.4822	59.0739	63.4115	68.0737	71.2399	74.4062 (38)
Heat transfer coeff	245.6800	244.0969	242.5138	234.5982	233.0151	225.4236	225.4236	224.0153	228.3529	233.0151	236.1814	239.3476 (39)
Average = Sum(39)m / 12 =												234.3053

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	3.5452	3.5223	3.4995	3.3853	3.3624	3.2529	3.2529	3.2325	3.2951	3.3624	3.4081	3.4538 (40)
HLP (average)												3.3810
Days in month	31	28	31	30	31	30	31	31	30	31	30	31

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2290 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths												70.7627 (42b)
Hot water usage for other uses												37.4573 (42c)
Average daily hot water use (litres/day)												99.8828 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	108.4601	106.0435	103.1965	99.0964	95.6842	92.0488	90.8209	93.6575	96.6251	100.4197	104.5761	108.2200 (44)
Energy content	171.7742	151.0045	158.6091	135.6580	128.8093	113.1847	109.8399	115.9675	119.1484	136.2686	148.9879	169.4464 (45)
Energy content (annual)												Total = Sum(45)m = 1658.6986
Distribution loss (46)m = 0.15 x (45)m												25.4170 (46)

Water storage loss:  
 Store volume 125.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day):  
 Temperature factor from Table 2b 1.0500 (48)  
 Enter (49) or (54) in (55) 0.5400 (49)  
 Total storage loss 0.5670 (55)

If cylinder contains dedicated solar storage												17.5770 (56)
Primary loss												23.2624 (57)
Combi loss												0.0000 (61)
Total heat required for water heating calculated for each month												212.6136 (62)

WWHRS												0.0000 (63a)
PV diverter												-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												581.8506 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												581.8506
Solar input	-0.0000	-16.2769	-56.3965	-75.7629	-96.3332	-88.2739	-87.3732	-77.7929	-55.2318	-28.4093	-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												212.6136 (64)
Electric shower(s)												0.0000 (64a)
Heat gains from water heating, kWh/month	89.7864	79.7188	84.2925	71.3210	65.2651	59.1661	58.7717	61.5536	66.9121	76.8642	81.1561	89.0124 (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	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												22.2965 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												279.1416 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												50.6031 (69)
Pumps, fans												3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												-89.1604 (71)
Water heating gains (Table 5)												119.6404 (72)
Total internal gains	532.5841	531.1373	514.5700	480.2671	445.4155	416.2004	400.7374	403.8716	425.3064	458.7486	491.6698	519.2618 (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
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Electricity for pumps and fans:	
pump for solar water heating	80.0000 (230g)
Total electricity for the above, kWh/year	80.0000 (231)
Electricity for lighting (calculated in Appendix L)	153.2458 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-929.8933 (233)
Wind generation	-3575.5408 (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	3954.8936 (238)



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10a. Fuel costs - using Table 12 prices  
-----

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	6302.2057	16.4900	1039.2337 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	852.2139	16.4900	140.5301 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	153.2458	16.4900	25.2702 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-929.8933	16.4900	-153.3394
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-153.3394 (252)
Wind Turbine electricity used in dwelling	-2502.8785	16.4900	-412.7247
Wind Turbine electricity exported	0.0000	5.5900	0.0000
Total			-412.7247 (252)
Total energy cost			652.1620 (255)

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11a. SAP rating - Individual heating systems  
-----

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	2.0541 (257)
SAP value		66.7038
SAP rating (Section 12)		67 (258)
SAP band		D

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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	6302.2057	0.1524	960.5666 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	852.2139	0.1468	125.1042 (264)
Space and water heating			1085.6709 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	153.2458	0.1443	22.1181 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-929.8933	0.1362	-126.6525
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-126.6525 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-347.1801 (269)
Total CO2, kg/year			645.0534 (272)
CO2 emissions per m2			9.3100 (273)
EI value			92.4377
EI rating			92 (274)
EI band			A

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SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
-----

-----  
1. Overall dwelling characteristics  
-----

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	50.9000 (1b)	x 2.1800 (2b)	= 110.9620 (1b) - (3b)
First floor	18.4000 (1c)	x 4.9600 (2c)	= 91.2640 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	69.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	202.2260 (5)

-----  
2. Ventilation rate  
-----

m3 per hour



Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 20.0000 / (5) = 0.0989 (8)  
 Number of storeys in the dwelling (ns) = 5 (9)  
 Additional infiltration [(9) - 1] x 0.1 = 0.4000 (10)  
 Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction = 0.3500 (11)

Enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 = 0.0000 (12)  
 If no draught lobby, enter 0.05, else enter 0 = 0.0500 (13)  
 Percentage of windows and doors draught stripped = 100.0000 (14)  
 Window infiltration 0.25 - [0.2 \* (14) / 100] = 0.0500 (15)

Pressure test  
 Pressure Test Method No  
 Measured/design AP50 Blower Door 15.0000 (17)  
 Infiltration rate 0.9489 (18)  
 Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.9489 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000 (22)
Adj infilt rate	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750 (22a)
Effective ac	1.4233	1.3285	1.3285	1.1861	1.1861	1.0438	1.0438	1.0201	1.1150	1.2810	1.3047	1.3996 (22b)
	1.4233	1.3285	1.3285	1.1861	1.1861	1.0438	1.0438	1.0201	1.1150	1.2810	1.3047	1.3996 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window-New (Uw = 1.56)			17.2700	1.4684	25.3588		(27)
Door			4.3100	2.0000	8.6200		(26)
Heatloss Floor 1			50.9000	0.2000	10.1800	110.0000	5599.0000 (28a)
GF-Wall Existing	43.6600	18.1800	25.4800	0.2400	6.1152	0.0000	0.0000 (29a)
1F-Wall Existing	119.4600	3.4000	116.0600	0.2400	27.8544	0.0000	0.0000 (29a)
GF-Wall Insulated	28.3100		28.3100	0.5000	14.1550	0.0000	0.0000 (29a)
Pitch Roof-1	24.3000		24.3000	0.1600	3.8880	0.0000	0.0000 (30)
Pitch Roof-2	24.3000		24.3000	0.1600	3.8880	0.0000	0.0000 (30)
Pitch Roof-3	9.3000		9.3000	0.1600	1.4880	0.0000	0.0000 (30)
Pitch Roof-4	9.3000		9.3000	0.1600	1.4880	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m2)			309.5300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 103.0354		(33)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) = 5599.0000		(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							80.7937 (35)
Thermal bridges (Default value 0.200 * total exposed area)							61.9060 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	164.9414 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	94.9866	88.6542	88.6542	79.1555	79.1555	69.6568	69.6568	68.0737	74.4062	85.4879	87.0710	93.4035 (38)
Average = Sum(39)m / 12 =	259.9280	253.5956	253.5956	244.0969	244.0969	234.5982	234.5982	233.0151	239.3476	250.4293	252.0125	258.3449 (39)
												246.4716

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	3.7508	3.6594	3.6594	3.5223	3.5223	3.3853	3.3853	3.3624	3.4538	3.6137	3.6365	3.7279 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.2290 (42)
Hot water usage for mixer showers													0.0000 (42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	70.7627 (42b)
Hot water usage for other uses	71.0028	69.9483	68.4633	65.7254	63.6752	61.4019	60.1740	61.6485	63.2540	65.6866	68.4809	70.7627	37.4573 (42c)
Average daily hot water use (litres/day)	37.4573	36.0952	34.7331	33.3710	32.0090	30.6469	30.6469	32.0090	33.3710	34.7331	36.0952	37.4573	99.8828 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	108.4601	106.0435	103.1965	99.0964	95.6842	92.0488	90.8209	93.6575	96.6251	100.4197	104.5761	108.2200 (44)	
Energy content (annual)	171.7742	151.0045	158.6091	135.6580	128.8093	113.1847	109.8399	115.9675	119.1484	136.2686	148.9879	169.4464 (45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 1658.6986
Water storage loss:	25.7661	22.6507	23.7914	20.3487	19.3214	16.9777	16.4760	17.3951	17.8723	20.4403	22.3482	25.4170 (46)	
Store volume													125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.0500 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.5670 (55)
Total storage loss	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (56)	
If cylinder contains dedicated solar storage	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (57)	
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	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	212.6136	187.8917	198.0528	168.4264	156.8544	140.1000	137.6524	144.7105	153.2675	175.7122	188.5099	210.2858 (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	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	-0.0000	(63b)
Aperture area of solar collector														3.0000 (H1)
Zero-loss collector efficiency														0.8000 (H2)
Collector linear heat loss coefficient														1.8000 (H3)
Collector 2nd order heat loss coefficient														0.0000 (H4)
Collector loop efficiency														0.9000 (H5)
Incidence angle modifier														1.0000 (H6)
Overshading factor														0.8000 (H8)
Overall heat loss coefficient of system														6.5000 (H10)
Heat loss coefficient of collector loop														3.9667 (H11)
Dedicated solar storage volume														75.0000 (H12)
Effective solar volume														75.0000 (H14)
Reference volume														225.0000 (H15)
Storage tank correction coefficient														1.3161 (H16)
Heat delivered to hot water														692.0037 (H24)
														0.0000 (H29)
														692.0037
Solar input	-7.4961	-24.2399	-67.7065	-88.3819	-103.8199	-100.8460	-92.4150	-89.2953	-67.4992	-39.0166	-11.2874			-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	205.1175	163.6518	130.3462	80.0445	53.0345	39.2540	45.2374	55.4152	85.7683	136.6957	177.2225			210.2858 (64)
														Total per year (kWh/year) = Sum(64)m = 1382.0735 (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	89.7864	79.7188	84.2925	71.3210	65.2651	59.1661	58.7717	61.5536	66.9121	76.8642	81.1561			89.0124 (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	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	133.7407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.6935	19.2680	15.6698	11.8630	8.8678	7.4865	8.0895	10.5150	14.1132	17.9200	20.9152	22.2965	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	292.0266	295.0569	287.4206	271.1638	250.6425	231.3554	218.4704	215.4401	223.0764	239.3332	259.8545	279.1416	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.6031	50.6031	50.6031	50.6031	50.6031	50.6031	50.6031	50.6031	50.6031	50.6031	50.6031	50.6031	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-89.1604	-89.1604	-89.1604	-89.1604	-89.1604	-89.1604	-89.1604	-89.1604	-89.1604	-89.1604	-89.1604	-89.1604	(71)
Water heating gains (Table 5)	120.6807	118.6291	113.2963	99.0570	87.7220	82.1752	78.9943	82.7333	92.9335	103.3121	112.7168	119.6404	(72)
Total internal gains	532.5841	531.1373	514.5700	480.2671	445.4155	416.2004	400.7374	403.8716	425.3064	458.7486	491.6698	519.2618	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF or Table 6c	Access factor Table 6d	Gains W					
North	17.2700	14.1962	0.6300	0.7000	0.7700	74.9268 (74)						
Solar gains	74.9268	122.5928	210.9304	344.8256	439.6103	501.1741	433.6128	368.9649	261.2420	149.0854	89.4062	59.8976 (83)
Total gains	607.5109	653.7301	725.5004	825.0927	885.0258	917.3745	834.3503	772.8366	686.5484	607.8340	581.0760	579.1593 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)													21.0000 (85)
tau	5.9835	6.1329	6.1329	6.3716	6.3716	6.6295	6.6295	6.6746	6.4980	6.2104	6.1714	6.0202	
alpha	1.3989	1.4089	1.4089	1.4248	1.4248	1.4420	1.4420	1.4450	1.4332	1.4140	1.4114	1.4013	
util living area	0.9361	0.9273	0.9093	0.8725	0.8184	0.7307	0.6762	0.6899	0.7964	0.8835	0.9198	0.9380 (86)	
MIT	15.9659	16.1840	16.7010	17.5700	18.5961	19.5819	20.0676	20.0623	19.3923	18.2226	17.1071	16.0559 (87)	
Th 2	18.4216	18.4565	18.4565	18.5116	18.5116	18.5697	18.5697	18.5797	18.5403	18.4745	18.4655	18.4302 (88)	
util rest of house	0.9193	0.9083	0.8840	0.8336	0.7498	0.6022	0.4695	0.4790	0.6793	0.8333	0.8934	0.9214 (89)	
MIT 2	13.5453	13.8149	14.4300	15.4726	16.6613	17.7594	18.2389	18.2535	17.5962	16.2556	14.9302	13.6575 (90)	
Living area fraction									fLA = Living area / (4) =				2.9755 (91)
MIT	20.7478	20.8641	21.1873	21.7133	22.4184	23.1824	23.6802	23.6354	22.9404	22.1083	21.4074	20.7937 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.7478	20.8641	21.1873	21.7133	22.4184	23.1824	23.6802	23.6354	22.9404	22.1083	21.4074	20.7937 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9347	0.9265	0.9108	0.8809	0.8446	0.7971	0.7855	0.7968	0.8465	0.8980	0.9230	0.9369 (94)	
Useful gains	567.8477	605.6755	660.7634	726.8106	747.4663	731.2137	655.4221	615.8132	581.1343	545.8199	536.3104	542.6331 (95)	
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000 (96)	
Heat loss rate W	3807.3640	3668.0386	3471.0445	3030.0364	2567.5020	2036.8795	1754.8340	1709.2670	1996.2456	2581.4906	3126.8193	3718.5293 (97)	
Space heating kWh	2410.2001	2057.9080	2090.8491	1658.3226	1354.1065	0.0000	0.0000	0.0000	0.0000	1514.5390	1865.1664	2362.8668 (98a)	
Space heating requirement - total per year (kWh/year)												15313.9586	
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	2410.2001	2057.9080	2090.8491	1658.3226	1354.1065	0.0000	0.0000	0.0000	0.0000	1514.5390	1865.1664	2362.8668 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												15313.9586	
Space heating per m2													(98c) / (4) = 220.9806 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 %)													249.9000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	2410.2001	2057.9080	2090.8491	1658.3226	1354.1065	0.0000	0.0000	0.0000	0.0000	1514.5390	1865.1664	2362.8668	(98)
Space heating efficiency (main heating system 1)													
Space heating fuel (main heating system 1)	964.4658	823.4926	836.6743	663.5945	541.8594	0.0000	0.0000	0.0000	0.0000	606.0580	746.3651	945.5249	(211)
Space heating efficiency (main heating system 2)													
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	(212)
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	(213)
Water heating													
Water heating requirement	205.1175	163.6518	130.3462	80.0445	53.0345	39.2540	45.2374	55.4152	85.7683	136.6957	177.2225	210.2858	(64)
Efficiency of water heater (217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(216)
Fuel for water heating, kWh/month	117.1431	93.4619	74.4410	45.7136	30.2881	22.4180	25.8352	31.6478	48.9825	78.0672	101.2121	120.0947	(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	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	18.9882	15.2331	13.7157	10.0487	7.7619	6.3415	7.0807	9.2037	11.9547	15.6852	17.7164	19.5160	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.1382	-70.3411	-109.6355	-132.8761	-142.5863	-85.4018	-82.2882	-80.8067	-74.6579	-83.9559	-58.1358	-43.7084	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	-212.5732	-205.7160	-212.5732	-205.7160	-212.5732	(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													6128.0347 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													175.1000
Water heating fuel used													789.3052 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
pump for solar water heating													80.0000 (230g)
Total electricity for the above, kWh/year													80.0000 (231)
Electricity for lighting (calculated in Appendix L)													153.2458 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1017.5318 (233)
Wind generation													-3575.5408 (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													3630.1754 (238)

10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6128.0347	25.1600	1541.8135	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	789.3052	25.1600	198.5892	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	153.2458	25.1600	38.5567	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1017.5318	25.1600	-256.0110	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-256.0110	(252)
Wind Turbine electricity used in dwelling	-2502.8785	25.1600	-629.7242	
Wind Turbine electricity exported	0.0000	5.8100	0.0000	
Total			-629.7242	(252)
Total energy cost			913.3521	(255)

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	6128.0347	0.1522	932.6430	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	789.3052	0.1476	116.5267	(264)

Space and water heating			1049.1696 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	153.2458	0.1443	22.1181 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1017.5318	0.1370	-139.3748
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-139.3748 (269)
Wind Turbine electricity used in dwelling	-2502.8785	0.1387	-347.1801
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-347.1801 (269)
Total CO2, kg/year			595.8298 (272)

Επιμέτρηση Κατανάλωσης Ενέργειας για Συστήματα Θέρμανσης συμπεριλαμβανομένων μικρο-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	6128.0347	1.5634	9580.8178 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	789.3052	1.5462	1220.4112 (278)
Space and water heating			10801.2290 (279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240 (281)
Energy for lighting	153.2458	1.5338	235.0536 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1017.5318	1.5064	-1532.8184
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1532.8184 (283)
Wind Turbine electricity used in dwelling	-2502.8785	1.5128	-3786.3546
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-3786.3546 (283)
Total Primary energy kWh/year			5838.1336 (286)