Proposed 2 bed ground floor
218 Hampton Road,
Twickenham TW2 5NJ

Sustainability & Energy Statement

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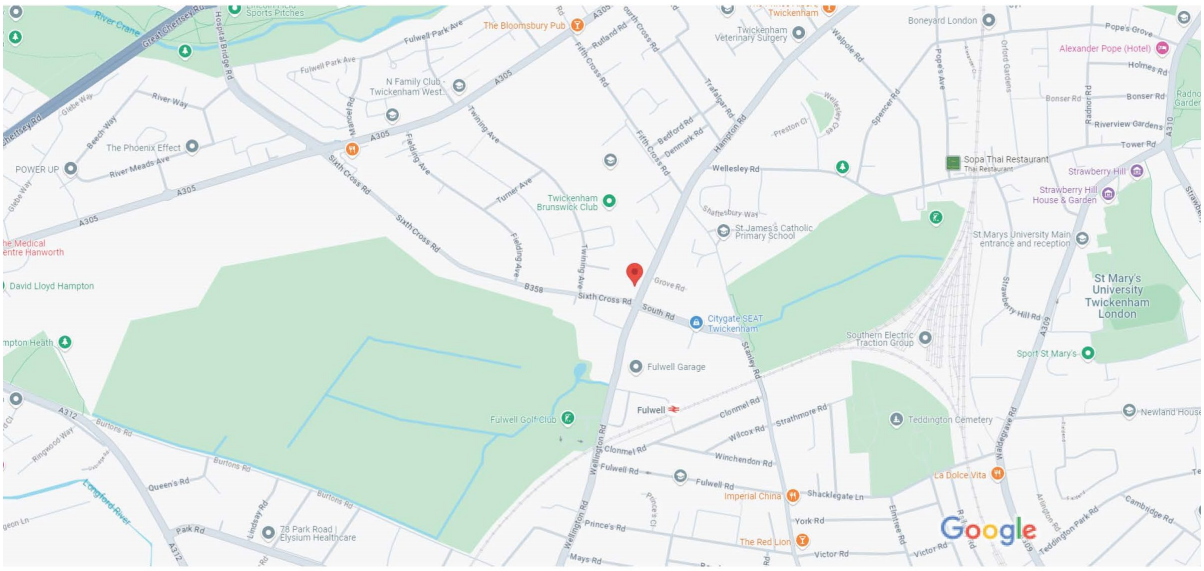
WEA Ltd
September 2024

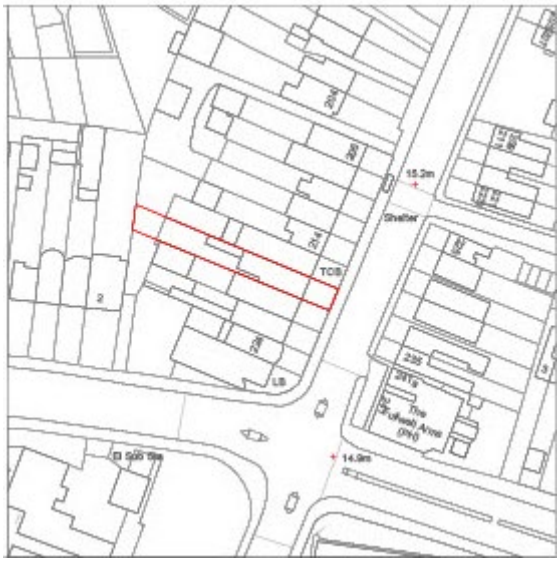
1.0 Executive summary

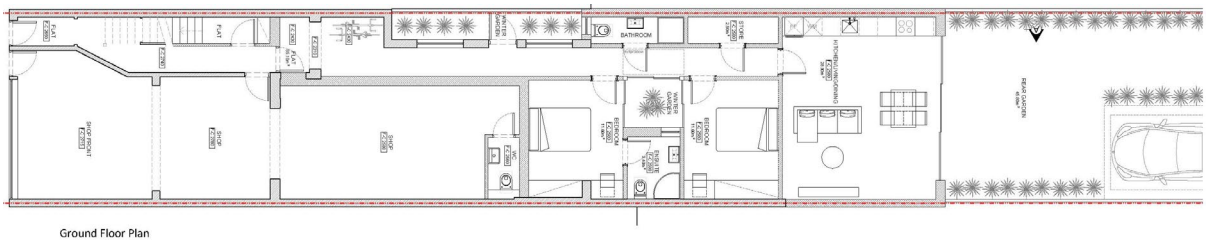
1.1 The Application

This sustainability & energy strategy has been prepared in support of a planning application for the construction of a 2-bed ground floor flat situated to the rear of an existing commercial unit.

This is an urban area, location close to the junction of the A311 (Hampton Rd) and B358 (Sixth Cross Road) in Twickenham.







The layout of the proposed flat

1.2 Policy and Drivers

This strategy summarises the relevant planning policies and requirements applicable to the dwellings in relation to Energy and Carbon Emissions. Of these, the principal target is to achieve 'Zero Carbon' (understood to correspond to a 100% reduction in regulated CO2 emissions beyond the requirements of the Building Regulations Part L1, as set out in the GLA guidance on preparing energy assessments (June 2022) and the GLA Sustainable Design and Construction SPG (April 2014), both relevant to Policy S1 2 of The London Plan (2021) and in accordance with LP20< LP21 & LP22 of LBRUT's Local Plan (adopted July 2018).

1.2.1 LP20: Climate Change Adaption

A. The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.

B. New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy:

1. minimise internal heat generation through energy efficient design

2. reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls

3. manage the heat within the building through exposed internal thermal mass and high ceilings

4. passive ventilation

5. mechanical ventilation

6. active cooling systems (ensuring they are the lowest carbon options).

C. Opportunities to adapt existing buildings, places and spaces to the likely effects of climate change should be maximised and will be supported.

1.3 Appraisals

The proposed new flat will be part existing construction with a new build extension forming the rear half of the property.

The dwelling has been assessed to determine the estimated regulated energy requirements and associated CO2 emissions, using Approved Document Ll. As this is part existing & part new build the assessment methodology will follow the ADL1B methodology.

1.4 Passive Design & Energy Efficiency Measures

A range of passive design and energy efficiency measures have been incorporated into the Development, including:

Suitable glazing ratio and low emissivity glass to balance heat losses, heat gains and daylight ingress.
All new fabric insulation levels achieving improvements over ADL1 minimum standards.
An ASHP supplying both heating & hot water
Low air permeability
100% low energy lighting
Roof Mounted PV panels

1.5 On-Site Renewable Energy Generation

A preliminary feasibility assessment of integrating low and zero carbon energy systems has been completed. The assessment is based on the plans dated June 2024. Based upon these it is estimated that an ASHP plus PV is the option technically most suited to this development.

It is anticipated that no further reduction in site-wide regulated CO2 emissions on the Building Regulations 'baseline' would be achieved via any additional on-site renewable energy generation and that the proposed measures will achieve a **40% reduction** in site-wide regulated CO2 emissions.

A summary of the anticipated CO2 emission reductions at each step of the energy hierarchy is shown below.

ADL1 2021			
	Kgs/year	Annual Saving Kgs	% Savings
A - Baseline	1,466	-	-
B - Be Lean	1,466	0	-
C - Be Clean	1,466	0	-
D - Be Green	879	587	40.0%
Cumulative on-site savings		587	
Target saving 35%		**513**	

As no changes or improvements are proposed to the remaining existing external walls, ground & separating first floor and roof, it is not possible for the flat to make any Be Lean CO2 emissions reductions.

New dwellings are assessed in SAP using ADL1A. The U values will be a least equal to those shown in ADL table 4.1, with calculated psi values and a requirement to undertake a post completion air test. The regulated CO2 emission improvements are derived from the DER (Dwelling Emission Rating) worksheet with the base figures derived from the TER (Target Emission Rating) worksheet. The dwelling passes when the DER is an improvement on the TER. The TER calculation for new dwelling also includes an element of assumed PV and sets the air permeability at 5.

With L1B calculations, when existing elements are left unchanged or even improved to the values in ADL Table 4.3 the U values will always be worse than those for a new build (Table 4.1) and as there is no information on the thermal bridging, or lack off, between existing thermal elements psi values will be assumed as defaults. Although air testing is an option with L1B, the higher U values for the existing fabric plus the higher psi values keeps the Be Lean DER above the base figure.

2.0 Current planning policy and guidance

The following outlines the regulatory and planning policy requirements applicable to the Development.

2.0.1 Approved Document Part L

Part L of the Building Regulations is the mechanism by which government is driving reductions in the regulated CO2 emissions from new buildings.

2.0.2 The London Plan

The London Plan sets target reduction in CO2 emissions for new buildings is 'Zero Carbon'. In this context this is assumed to be a 100% reduction in regulated CO2 emissions, with a minimum saving of 35%.

2.0.3 LBRUT's Council Adopted Local Plan – adopted July2018

LBRUT's Local Plan – Core Strategy was adopted by the Council in July 2018. LP20, 21 & 22 are the policies specific to this report.

2.0.2 LP21 - Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.

2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).

3. New non-residential buildings over 100sqm will be required to meet BREEAM ‘Excellent’ standard.

4. Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).

Reducing Carbon Dioxide Emissions

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1. All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
2. All other new residential buildings should achieve a 35% reduction.
3. All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. This should be achieved by following the Energy Hierarchy:

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Decentralised Energy Networks
D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

1. All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.

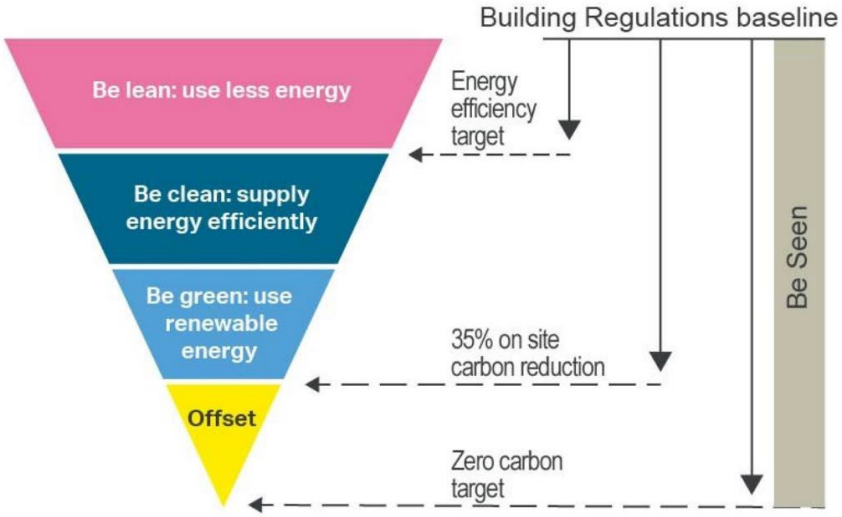
2. Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).

3.0 Statement of Energy Use

3.1 Energy

This strategy outlines how the dwelling will have a reduced impact on climate change by reducing CO2 emissions associated with energy use in buildings.

The Energy and CO2 appraisal is based on the following approach, in line with GLA policy:



The strategic approach to the design has been to reduce demand for energy prior to the consideration of integrating Low or Zero Carbon (LZC) technologies, since controlling demand is the most effective way of reducing energy requirements and CO2 emissions.

Further reductions are ensured through the specification of high efficiency building services to limit losses in energy supply, storage, and distribution.

After the inclusion of passive design and energy efficiency measures, various options have been investigated to reduce CO2 emissions associated with energy supply.

The feasibility of LZC technologies has been investigated in line with the policy aspirations and as part of the Energy Strategy submitted in support of the application.

4.2 Carbon Factors

The following compliant CO2 emission factors in Table below were used to convert the energy requirement figures into CO2 emissions.

Emission factor (kgCO2/kWh)	
Fuel	
Gas	0.210
Electricity	0.233

5.0 The Assessment - Be Lean

The following sections detail the passive design and energy efficiency measures that have been considered, and those that will be implemented.

5.1 Passive Design Measures

Passive design measures are those which reduce the energy demand within buildings, without triggering an energy requirement in the process.

These are the most effective and robust measures for reducing CO2 emissions as the performance of the solutions (e.g., wall insulation), is unlikely to deteriorate significantly with time or be subject to change by future property owners. In this sense, we can be confident that the benefits of these measures will continue at a similar level for the duration of their installation.
The Passive Design Measures considered during the design process include the following:

5.2 Glazing Ratio

The design has taken a ‘fabric first’ approach to reducing energy demand and CO2 emissions. Glazing ratio has been optimised to achieve a balance between providing natural daylighting to reduce the use of artificial lighting, the provision of passive solar heating to limit the need for space heating in winter and limiting summertime solar gains to reduce space cooling demands and limit the likelihood of high internal temperatures. Glazing on the south, east and west facing facades can lead to beneficial solar gains in winter months, whilst glazing on northerly orientations will typically loose heat. All glazing will be thermally efficient, using low emissivity glass and argon filled double glazed units.

5.3 Glazing Energy and Light Transmittance

In designing the elevations with an appropriate approach to fenestration, the design team has also been mindful to balance the solar energy transmittance and light transmittance values of the glass, to control solar gains and to maximise daylight respectively.
Solar gains can be beneficial in winter months as a means of avoiding the need for active heating to maintain comfortable internal temperatures. However, in summer months excessive solar gains can lead to the potential for high internal temperatures.
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5.4 Thermal Insulation

Demand for space heating can be significant in residential units. However, the demand can be significantly reduced through the provision of an efficient thermal

envelope, by reducing the thermal transmittance of the building envelope where appropriate and reduce heating requirements.

All new thermal elements in the dwelling will be construction using U values that are better than Table 4.1 of the current Building Regulation ADL 2021

5.6 Ventilation

The flat will be naturally ventilated.

5.7 Metering & Controls

It is intended that the dwelling will benefit from smart metering which will allow the occupants to instantaneously view the energy requirements. This will be provided to the incoming electricity and gas supply.

The heating system will be provided with zonal, programmable thermostatic controls linked to a master control panel which will allow occupants to control each zone independently for maximum flexibility. Hot water will be separately programmable.

Any radiators provided within units will have thermostatic radiator valves (TRV) to enable occupants to moderate the temperature in their rooms.

5.8 Input U Values

An initial SAP calculation has been completed using the following U Values for any **new** fabric elements.

	ADLA Table 4.2	Design U values
Roof (slope & Flat)	0.20	0.14
Roof (Plane)	0.20	0.11
Walls	0.30	0.18
Ground Floor	0.25	0.12
Windows	2.0	1.4
Air Permeability	8.0	N/A (L1B assessment)

6.0 The Assessment - Be Clean

The following looks at the infrastructure and clean energy supply measures that have been considered for the dwelling to further reduce regulated CO2 emissions and outlines any technologies that may be implemented.

6.1 Infrastructure

The infrastructure, including decentralised energy networks and on-site technologies, can be the key to achieving the target reduction in regulated CO2 emissions beyond the requirements of the Building Regulations ADL1

6.2 Decentralised Energy Networks

By reference to the London Heat Map (http://www.londonheatmap.org.uk), there are no existing or planned heat networks in the near vicinity.
No provisions will be made for connection to an existing/planned network.

6.3 On-Site Technologies

As this a single residential unit, with the heat demand during the summer months limited to hot water use, CHP is not a viable option due to this seasonality of the heat demand.

7.0 Be Green

The renewable energy generation measures that have been considered, and those which will be implemented are considered below.

Renewable technologies harness energy from the environment and convert this to a useful form. Many renewable technologies are available. However, not all these are commercially viable or appropriate.

Technology	Criteria	Assessment
Biofuels	Not practical for this dwelling as a flue is required, plus storage space	Not considered suitable
Ground Source Heat Pump	Insufficient space for horizontal coil or separation of multiple boreholes	Not considered suitable
Air Source Heat Pump	Sufficient space for ASHP and auxiliary equipment	ASHP would meet the CO2 reduction targets
Solar PV	Suitable roof orientation, lack of shading insufficient roof space	Limited space on roof of the building more than 10kWp required to achieve 20% reduction
Solar thermal	Suitable roof orientation system.	Carbon savings low would not reduce CO2 emissions by more than 5%.
Wind turbines	Insufficient wind speed.	Not considered suitable

Based upon the assessment of the renewable/low carbon technologies listed above the chosen option is an ASHP plus a limited area of PV (1m2)

8.0 Flood risk and internal water consumption

The Core Strategy (LP21) requires that all developments should avoid, or minimise, contributing to all sources of flooding, including fluvial, tidal, surface water, groundwater and flooding from sewers, taking account of climate change and without increasing flood risk elsewhere.

This can be achieved by applying the following criteria to the dwellings:

- directing dwelling away from areas at high risk from flooding and aiming to achieve an overall reduction in flood risk; requiring sequential and exception test and flood risk assessments (FRAs) in accordance with requirements set out in National Policy **(18)**
- improving the sustainability of buildings against flood risk, water stress and overheating, to not put people or property at unacceptable risk.

8.1.1 Flood Risk – sea, rivers & streams

According to the Environment Agency's Flood Risk plans the dwelling is in Zone 1, an area of low flood risk for sea, rivers & streams.

8.1.2 Flood Risk – groundwater & reservoirs

The Environment Agency's Flood Risk plan for groundwater & reservoirs indicates that flooding from these sources is very unlikely has a very low probability.

8.2 Surface Water Drainage

The risk of flooding from surface water is low
Post construction there will be a smaller area a of hard standing than for the existing site, reducing the surface water run-off from the site.

8.3 Internal water consumption

Internal water consumption will be limited to 110litres/person/day. This will be achieved by providing low flow taps and showers, low-capacity baths and dual flush 4/2.6 litre WC cisterns. An initial water calculation is included in the Appendices.

9.0 Conclusions

This Energy Strategy has demonstrated that the combination of an ASHP and PV panels, the dwelling will achieve an overall 40% reduction in site-wide regulated CO2 emissions.

APPENDICES

Sample initial SAP Worksheet

Water calculation

Full SAP Calculation Printout

Property Reference	MMN Hampton Rd 218	**Issued on Date**	09/09/2024
Assessment Reference	HR 218	**Prop Type Ref**	
Property	New Ground Floor Flat, 218, Hampton Road, Twickenham, TW2 5HJ		

SAP Rating	56 D	**DER**	11.01	**TER**	18.36
Environmental	91 B	**% DER < TER**			40.03
CO_2 Emissions (t/year)	0.72	**DFEE**	142.13	**TFEE**	63.50
Compliance Check	See BREL	**% DFEE < TFEE**			-123.81
% DPER < TPER	-17.76	**DPER**	114.43	**TPER**	97.18

Assessor Details	Mr. Paul Goodhand	**Assessor ID**	L682-0001
Client			

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		79.8500 (1b)	x	3.0900 (2b)	=	246.7365	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.8500						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.7365	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	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) =	0.0811	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8311	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7064	(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	0.9007	0.8830	0.8653	0.7770	0.7594	0.6711	0.6711	0.6534	0.7064	0.7594	0.7947	0.8300	(22b)
Effective ac	0.9056	0.8898	0.8744	0.8019	0.7883	0.7252	0.7252	0.7135	0.7495	0.7883	0.8158	0.8445	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
windows (Uw = 1.40)			28.2100	1.3258	37.3996			(27)
entrance door			1.7900	1.4000	2.5060			(26a)
Opening			1.3000	1.3258	1.7235			(27a)
Heatloss Floor new			65.8900	0.1100	7.2479			(28a)
Heatloss Floor existing			17.1700	0.7700	13.2209			(28a)
External Wall Existing	33.7700		33.7700	1.4700	49.6419			(29a)
External Wall new	99.3400	28.2100	71.1300	0.1800	12.8034			(29a)
sheltered wall	16.5400	1.7900	14.7500	0.1800	2.6550			(29a)
External Roof 1	65.8900	1.3000	64.5900	0.1300	8.3967			(30)
External Roof existing	17.1700		17.1700	0.4000	6.8680			(30)
Total net area of external elements Aum(A, m2)			315.7700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		142.4629			(33)
Party Wall 1			22.3700	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.200 * total exposed area)	63.1540	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	205.6169	(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	73.7362	72.4538	71.1968	65.2927	64.1881	59.0459	59.0459	58.0936	61.0266	64.1881	66.4228	68.7590	(38)
Heat transfer coeff													
	279.3531	278.0707	276.8137	270.9096	269.8050	264.6628	264.6628	263.7105	266.6435	269.8050	272.0397	274.3759	(39)
Average = Sum(39)m / 12 =												270.9044	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.4985	3.4824	3.4667	3.3927	3.3789	3.3145	3.3145	3.3026	3.3393	3.3789	3.4069	3.4361	(40)
HLP (average)												3.3927	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4600	(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													
	79.4600	78.2799	76.6181	73.5540	71.2596	68.7156	67.3414	68.9916	70.7883	73.5106	76.6378	79.1914	(42b)
Hot water usage for other uses													
	41.9189	40.3946	38.8702	37.3459	35.8216	34.2973	34.2973	35.8216	37.3459	38.8702	40.3946	41.9189	(42c)
Average daily hot water use (litres/day)												111.7800	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	121.3789	118.6745	115.4883	110.8999	107.0812	103.0128	101.6387	104.8132	108.1343	112.3808	117.0323	121.1103	(44)
Energy conte	192.2345	168.9909	177.5013	151.8165	144.1519	126.6663	122.9231	129.7806	133.3404	152.4997	166.7340	189.6294	(45)
Energy content (annual)										Total = Sum(45)m =		1856.2686	
Distribution loss (46)m = 0.15 x (45)m													
	28.8352	25.3486	26.6252	22.7725	21.6228	18.9999	18.4385	19.4671	20.0011	22.8750	25.0101	28.4444	(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													
	192.2345	168.9909	177.5013	151.8165	144.1519	126.6663	122.9231	129.7806	133.3404	152.4997	166.7340	189.6294	(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													
	192.2345	168.9909	177.5013	151.8165	144.1519	126.6663	122.9231	129.7806	133.3404	152.4997	166.7340	189.6294	(64)
										Total per year (kWh/year) = Sum(64)m =		1856.2686	(64)
12Total per year (kWh/year)												1856	(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													
	63.9180	56.1895	59.0192	50.4790	47.9305	42.1165	40.8719	43.1521	44.3357	50.7062	55.4391	63.0518	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	110.5243	122.3662	110.5243	114.2084	110.5243	114.2084	110.5243	110.5243	114.2084	110.5243	114.2084	110.5243	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	219.1268	221.4006	215.6706	203.4720	188.0735	173.6011	163.9327	161.6588	167.3889	179.5874	194.9859	209.4583	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	(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)													
	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	(71)
Water heating gains (Table 5)													
	85.9113	83.6153	79.3268	70.1097	64.4227	58.4952	54.9354	58.0001	61.5773	68.1534	76.9987	84.7470	(72)
Total internal gains													
	478.4624	490.2822	468.4218	450.6903	425.9207	406.2049	389.2925	390.0833	403.0747	421.1653	449.0932	467.6297	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.1200	10.6334	0.6300	0.7000	0.7700	32.8870	(74)
East	3.4400	19.6403	0.6300	0.7000	0.7700	20.6480	(76)
West	14.6500	19.6403	0.6300	0.7000	0.7700	87.9340	(80)
West	1.3000	26.0000	0.6300	0.7000	1.0000	13.4152	(82)

Solar gains	154.8842	303.1205	506.1364	759.1103	955.3847	990.6149	937.8242	787.6637	594.5803	360.9088	192.9863	127.5441	(83)
Total gains	633.3466	793.4027	974.5583	1209.8005	1381.3055	1396.8198	1327.1168	1177.7470	997.6551	782.0741	642.0795	595.1739	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	19.8499	19.9415	20.0320	20.4686	20.5524	20.9517	20.9517	21.0274	20.7961	20.5524	20.3836	20.2100	
alpha	2.3233	2.3294	2.3355	2.3646	2.3702	2.3968	2.3968	2.4018	2.3864	2.3702	2.3589	2.3473	
util living area													
	0.9916	0.9853	0.9720	0.9381	0.8739	0.7701	0.6583	0.7164	0.8785	0.9646	0.9873	0.9929	(86)
MIT	18.0216	18.2578	18.6980	19.3389	19.9388	20.4262	20.6625	20.6057	20.1785	19.4020	18.6248	18.0133	(87)
Th 2	18.5215	18.5282	18.5348	18.5665	18.5725	18.6010	18.6010	18.6063	18.5899	18.5725	18.5604	18.5478	(88)

util rest of house													
	0.9882	0.9792	0.9592	0.9064	0.7983	0.6032	0.3713	0.4435	0.7659	0.9402	0.9808	0.9899	(89)
MIT 2	15.3243	15.6283	16.1896	17.0045	17.7166	18.2370	18.4034	18.3879	18.0257	17.1063	16.1163	15.3274	(90)
Living area fraction										fLA = Living area / (4) =		0.3761	(91)
MIT	16.3387	16.6172	17.1330	17.8824	18.5523	19.0603	19.2530	19.2220	18.8353	17.9696	17.0597	16.3375	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.3387	16.6172	17.1330	17.8824	18.5523	19.0603	19.2530	19.2220	18.8353	17.9696	17.0597	16.3375	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9716	0.9481	0.8935	0.7975	0.6443	0.4679	0.5341	0.7824	0.9306	0.9742	0.9855	(94)
Useful gains	622.6784	770.8508	923.9665	1080.9893	1101.5228	899.9197	620.9008	629.0859	780.5208	727.7711	625.5375	586.5622	(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													
	3363.0484	3258.2024	2943.3500	2433.4278	1848.7906	1180.4806	702.1435	744.1887	1262.6391	1988.3656	2709.4353	3330.2509	(97)
Space heating kWh													
	2038.8353	1671.5003	1502.4213	973.7558	555.9672	0.0000	0.0000	0.0000	0.0000	937.8823	1500.4064	2041.3044	(98a)
Space heating requirement - total per year (kWh/year)												11222.0731	
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													
	2038.8353	1671.5003	1502.4213	973.7558	555.9672	0.0000	0.0000	0.0000	0.0000	937.8823	1500.4064	2041.3044	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												11222.0731	
Space heating per m2											(98c) / (4) =	140.5394	(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 %)	219.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2038.8353	1671.5003	1502.4213	973.7558	555.9672	0.0000	0.0000	0.0000	0.0000	937.8823	1500.4064	2041.3044	(98)
Space heating efficiency (main heating system 1)													
	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)													
	929.7015	762.1980	685.0986	444.0291	253.5190	0.0000	0.0000	0.0000	0.0000	427.6709	684.1799	930.8274	(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													
	192.2345	168.9909	177.5013	151.8165	144.1519	126.6663	122.9231	129.7806	133.3404	152.4997	166.7340	189.6294	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month													
	100.9635	88.7557	93.2255	79.7355	75.7101	66.5264	64.5605	68.1621	70.0317	80.0944	87.5704	99.5953	(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	22.9648	18.4232	16.5880	12.1531	9.3874	7.6696	8.5635	11.1312	14.4583	18.9701	21.4266	23.6030	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-11.5117	-20.0666	-36.1092	-49.0359	-58.1063	-49.1193	-48.0801	-42.3688	-33.1235	-25.2711	-13.6773	-9.4669	(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	-1.1576	-3.0683	-8.1480	-16.6007	-27.9424	-37.3834	-36.4848	-28.3082	-17.7194	-5.6661	-1.7541	-0.8569	(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	5117.2244	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	974.9310	(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)	185.3388	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-581.0267	(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	5696.4675	(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	5117.2244	0.1541	788.4731	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	974.9310	0.1415	137.9948	(264)
Space and water heating			926.4678	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	185.3388	0.1443	26.7501	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-395.9367	0.1322	-52.3568	
PV Unit electricity exported	-185.0900	0.1163	-21.5285	
Total			-73.8852	(269)
Total CO2, kg/year			879.3327	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.0100	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5117.2244	1.5705	8036.3616	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	974.9310	1.5234	1485.2164	(278)
Space and water heating			9521.5779	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	185.3388	1.5338	284.2788	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-395.9367	1.4886	-589.3948	
PV Unit electricity exported	-185.0900	0.4261	-78.8757	
Total			-668.2705	(283)
Total Primary energy kWh/year			9137.5862	(286)
Dwelling Primary energy Rate (DPER)			114.4300	(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	79.8500 (1b)	x	3.0900 (2b)	=	246.7365	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 79.8500						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.7365	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1216	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3716	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3158	(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	0.4027	0.3948	0.3869	0.3474	0.3395	0.3001	0.3001	0.2922	0.3158	0.3395	0.3553	0.3711	(22b)
Effective ac	0.5811	0.5779	0.5749	0.5604	0.5576	0.5450	0.5450	0.5427	0.5499	0.5576	0.5631	0.5689	(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			1.7900	1.0000	1.7900			(26a)
TER Opening Type (Uw = 1.20)			17.3700	1.1450	19.8893			(27)
Opening			0.8000	1.5918	1.2734			(27a)
Heatloss Floor new			65.8900	0.1300	8.5657			(28a)
Heatloss Floor existing			17.1700	0.1300	2.2321			(28a)
External Wall Existing	33.7700		33.7700	0.1800	6.0786			(29a)
External Wall new	99.3400	17.3700	81.9700	0.1800	14.7546			(29a)
sheltered wall	16.5400	1.7900	14.7500	0.1800	2.6550			(29a)
External Roof 1	65.8900	0.8000	65.0900	0.1100	7.1599			(30)

External Roof existing						17.1700		17.1700	0.1100	1.8887			(30)
Total net area of external elements Aum(A, m2)						315.7700							(31)
Fabric heat loss, W/K = Sum (A x U)							(26)...(30) + (32) =		66.2873				(33)
Party Wall 1						22.3700		0.0000	0.0000				(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		15.7885 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	82.0758 (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	47.3138	47.0575	46.8062	45.6258	45.4050	44.3769	44.3769	44.1866	44.7729	45.4050	45.8517	46.3188	(38)
Heat transfer coeff	129.3897	129.1333	128.8820	127.7016	127.4808	126.4528	126.4528	126.2624	126.8488	127.4808	127.9276	128.3946	(39)
Average = Sum(39)m / 12 =												127.7006	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6204	1.6172	1.6141	1.5993	1.5965	1.5836	1.5836	1.5812	1.5886	1.5965	1.6021	1.6079	(40)
HLP (average)												1.5993	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4600	(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	75.4870	74.3659	72.7872	69.8763	67.6967	65.2798	63.9743	65.5420	67.2489	69.8351	72.8059	75.2318	(42b)
Hot water usage for other uses	39.8230	38.3748	36.9267	35.4786	34.0305	32.5824	32.5824	34.0305	35.4786	36.9267	38.3748	39.8230	(42c)
Average daily hot water use (litres/day)												106.1910	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3100	112.7408	109.7139	105.3549	101.7272	97.8622	96.5567	99.5725	102.7275	106.7618	111.1807	115.0548	(44)
Energy conte	182.6228	160.5413	168.6262	144.2256	136.9443	120.3330	116.7770	123.2916	126.6733	144.8747	158.3973	180.1479	(45)
Energy content (annual)										Total = Sum(45)m =		1763.4552	
Distribution loss (46)m = 0.15 x (45)m	27.3934	24.0812	25.2939	21.6338	20.5417	18.0499	17.5165	18.4937	19.0010	21.7312	23.7596	27.0222	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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	229.2177	202.6271	215.2211	189.3175	183.5392	165.4248	163.3719	169.8865	171.7652	191.4696	203.4892	226.7428	(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	229.2177	202.6271	215.2211	189.3175	183.5392	165.4248	163.3719	169.8865	171.7652	191.4696	203.4892	226.7428	(64)
										Total per year (kWh/year) = Sum(64)m =		2312.0726	(64)
12Total per year (kWh/year)												2312	(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	97.9980	87.0486	93.3441	84.0285	82.8099	76.0842	76.1043	78.2704	78.1924	85.4468	88.7406	97.1751	(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	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	110.5243	122.3662	110.5243	114.2084	110.5243	114.2084	110.5243	110.5243	114.2084	110.5243	114.2084	110.5243	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.1268	221.4006	215.6706	203.4720	188.0735	173.6011	163.9327	161.6588	167.3889	179.5874	194.9859	209.4583	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	(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)	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	(71)
Water heating gains (Table 5)	131.7177	129.5366	125.4626	116.7062	111.3036	105.6725	102.2907	105.2021	108.6005	114.8478	123.2508	130.6117	(72)
Total internal gains	524.2689	536.2035	514.5576	497.2868	472.8016	453.3822	436.6478	437.2854	450.0979	467.8597	495.3453	513.4944	(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	6.2300	10.6334	0.6300	0.7000	0.7700	20.2456	(74)
East	2.1200	19.6403	0.6300	0.7000	0.7700	12.7249	(76)
West	9.0200	19.6403	0.6300	0.7000	0.7700	54.1409	(80)
West	0.8000	26.0000	0.6300	0.7000	1.0000	8.2555	(82)

Solar gains	95.3670	186.6403	311.6417	467.4008	588.2476	609.9377	577.4344	484.9805	366.0979	222.2220	118.8276	78.5329	(83)
Total gains	619.6359	722.8438	826.1992	964.6877	1061.0493	1063.3199	1014.0822	922.2659	816.1958	690.0816	614.1729	592.0273	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.8561	42.9412	43.0249	43.4226	43.4978	43.8515	43.8515	43.9176	43.7146	43.4978	43.3459	43.1882	
alpha	3.8571	3.8627	3.8683	3.8948	3.8999	3.9234	3.9234	3.9278	3.9143	3.8999	3.8897	3.8792	
util living area	0.9942	0.9889	0.9758	0.9334	0.8375	0.6768	0.5239	0.5875	0.8234	0.9608	0.9895	0.9952	(86)
MIT	19.0899	19.3122	19.6847	20.1999	20.6314	20.8885	20.9687	20.9515	20.7473	20.1772	19.5482	19.0572	(87)
Th 2	19.5984	19.6007	19.6030	19.6139	19.6159	19.6254	19.6254	19.6271	19.6217	19.6159	19.6118	19.6075	(88)
util rest of house	0.9922	0.9850	0.9668	0.9077	0.7755	0.5630	0.3721	0.4317	0.7316	0.9405	0.9850	0.9935	(89)
MIT 2	17.4331	17.7173	18.1894	18.8296	19.3191	19.5665	19.6170	19.6122	19.4569	18.8188	18.0271	17.3973	(90)
Living area fraction									fLA = Living area / (4) =			0.3761	(91)
MIT	18.0562	18.3171	18.7518	19.3449	19.8126	20.0637	20.1254	20.1159	19.9422	19.3297	18.5992	18.0215	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0562	18.3171	18.7518	19.3449	19.8126	20.0637	20.1254	20.1159	19.9422	19.3297	18.5992	18.0215	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9888	0.9798	0.9593	0.9015	0.7856	0.6021	0.4296	0.4905	0.7564	0.9348	0.9802	0.9905	(94)
Useful gains	612.6962	708.2459	792.6129	869.6455	833.5501	640.2590	435.6782	452.3637	617.3580	645.0921	602.0345	586.4212	(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	1779.9061	1732.5986	1579.0335	1333.8342	1034.2045	690.8990	445.7905	469.1741	741.0782	1112.8629	1471.0625	1774.6113	(97)
Space heating kWh	868.4042	688.3650	585.0969	334.2159	149.2869	0.0000	0.0000	0.0000	0.0000	348.0215	625.7002	884.0134	(98a)
Space heating requirement - total per year (kWh/year)												4483.1039	
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	868.4042	688.3650	585.0969	334.2159	149.2869	0.0000	0.0000	0.0000	0.0000	348.0215	625.7002	884.0134	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4483.1039	
Space heating per m2											(98c) / (4) =	56.1441	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 92.3000 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	868.4042	688.3650	585.0969	334.2159	149.2869	0.0000	0.0000	0.0000	0.0000	348.0215	625.7002	884.0134	(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)	940.8496	745.7909	633.9078	362.0974	161.7410	0.0000	0.0000	0.0000	0.0000	377.0547	677.8983	957.7610	(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	229.2177	202.6271	215.2211	189.3175	183.5392	165.4248	163.3719	169.8865	171.7652	191.4696	203.4892	226.7428	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7567	86.5794	86.1860	85.3203	83.6005	79.8000	79.8000	79.8000	79.8000	85.3824	86.4084	86.8016	(217)
Fuel for water heating, kWh/month	264.2075	234.0362	249.7169	221.8902	219.5432	207.2993	204.7267	212.8903	215.2446	224.2496	235.4969	261.2197	(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	22.9648	18.4232	16.5880	12.1531	9.3874	7.6696	8.5635	11.1312	14.4583	18.9701	21.4266	23.6030	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.9847	-39.1778	-57.9758	-67.1718	-74.1435	-69.8194	-68.9527	-64.2441	-56.2324	-45.6722	-30.0632	-23.1984	(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	-11.9873	-25.5285	-51.3226	-77.9430	-103.9046	-104.7149	-103.4937	-87.2521	-63.4517	-36.8042	-16.0996	-9.4571	(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 4857.1007 (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 2750.5211 (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) 185.3388 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation -1315.5954 (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	6563.3651	(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	4857.1007	0.2100	1019.9911	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2750.5211	0.2100	577.6094	(264)
Space and water heating			1597.6006	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	185.3388	0.1443	26.7501	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-623.6360	0.1340	-83.5498	
PV Unit electricity exported	-691.9594	0.1256	-86.8886	
Total			-170.4384	(269)
Total CO2, kg/year			1465.8416	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			18.3600	(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	4857.1007	1.1300	5488.5238	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2750.5211	1.1300	3108.0889	(278)
Space and water heating			8596.6126	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	185.3388	1.5338	284.2788	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-623.6360	1.4951	-932.4005	
PV Unit electricity exported	-691.9594	0.4609	-318.9299	
Total			-1251.3304	(283)
Total Primary energy kWh/year			7759.6618	(286)
Target Primary Energy Rate (TPER)			97.1800	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		79.8500 (1b)	x	3.0900 (2b)	=	246.7365	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.8500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.7365	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1216	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8716	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.7408	(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	0.9446	0.9261	0.9075	0.8149	0.7964	0.7038	0.7038	0.6853	0.7408	0.7964	0.8335	0.8705	(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	0.9461	0.9288	0.9118	0.8321	0.8171	0.7477	0.7477	0.7348	0.7744	0.8171	0.8473	0.8789	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
windows (Uw = 1.40)			28.2100	1.3258	37.3996			(27)
entrance door			1.7900	1.4000	2.5060			(26a)
Opening			1.3000	1.3258	1.7235			(27a)
Heatloss Floor new			65.8900	0.1100	7.2479			(28a)
Heatloss Floor existing			17.1700	0.7700	13.2209			(28a)
External Wall Existing	33.7700		33.7700	1.4700	49.6419			(29a)
External Wall new	99.3400	28.2100	71.1300	0.1800	12.8034			(29a)
sheltered wall	16.5400	1.7900	14.7500	0.1800	2.6550			(29a)
External Roof 1	65.8900	1.3000	64.5900	0.1300	8.3967			(30)
External Roof existing	17.1700		17.1700	0.4000	6.8680			(30)
Total net area of external elements Aum(A, m2)			315.7700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		142.4629			(33)
Party Wall 1			22.3700	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)		63.1540 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	205.6169 (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	77.0358	75.6253	74.2427	67.7488	66.5338	60.8777	60.8777	59.8303	63.0563	66.5338	68.9917	71.5613	(38)
Heat transfer coeff	282.6527	281.2422	279.8596	273.3657	272.1507	266.4946	266.4946	265.4472	268.6732	272.1507	274.6086	277.1782	(39)
Average = Sum(39)m / 12 =												273.3598	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.5398	3.5221	3.5048	3.4235	3.4083	3.3374	3.3374	3.3243	3.3647	3.4083	3.4391	3.4712	(40)
HLP (average)												3.4234	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.4600 (42)

Hot water usage for mixer showers

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

28.2757	27.8558	27.2644	26.1741	25.3576	24.4523	23.9633	24.5506	25.1899	26.1586	27.2714	28.1801	(42b)

Hot water usage for other uses

39.8230	38.3748	36.9267	35.4786	34.0305	32.5824	32.5824	34.0305	35.4786	36.9267	38.3748	39.8230	(42c)

Average daily hot water use (litres/day)	62.4187 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	68.0987	66.2306	64.1912	61.6527	59.3882	57.0348	56.5458	58.5811	60.6686	63.0854	65.6463	68.0031	(44)
Energy conte	107.8517	94.3116	98.6595	84.3995	79.9479	70.1309	68.3872	72.5356	74.8104	85.6063	93.5252	106.4764	(45)
Energy content (annual)										Total = Sum(45)m =		1036.6420	

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

91.6739	80.1648	83.8605	71.7396	67.9557	59.6113	58.1291	61.6553	63.5888	72.7653	79.4964	90.5049	(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

91.6739	80.1648	83.8605	71.7396	67.9557	59.6113	58.1291	61.6553	63.5888	72.7653	79.4964	90.5049	(64)

	Total per year (kWh/year) = Sum(64)m =	881.1457 (64)
12Total per year (kWh/year)		881 (64)

Electric shower(s)

52.4273	46.7132	51.0090	48.6773	49.5907	47.3047	48.8815	49.5907	48.6773	51.0090	50.0498	52.4273	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	596.3578 (64a)

Heat gains from water heating, kWh/month

36.0253	31.7195	33.7174	30.1042	29.3866	26.7290	26.7527	27.8115	28.0665	30.9436	32.3866	35.7331	(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	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	110.5243	122.3662	110.5243	114.2084	110.5243	114.2084	110.5243	110.5243	114.2084	110.5243	114.2084	110.5243	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.1268	221.4006	215.6706	203.4720	188.0735	173.6011	163.9327	161.6588	167.3889	179.5874	194.9859	209.4583	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	(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)	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	(71)
Water heating gains (Table 5)	48.4211	47.2016	45.3191	41.8114	39.4981	37.1236	35.9579	37.3810	38.9813	41.5908	44.9813	48.0283	(72)
Total internal gains	437.9723	450.8686	431.4141	419.3920	397.9961	384.8333	370.3150	369.4643	380.4787	391.6027	414.0758	427.9110	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.1200	10.6334	0.6300	0.7000	0.7700	32.8870	(74)
East	3.4400	19.6403	0.6300	0.7000	0.7700	20.6480	(76)
West	14.6500	19.6403	0.6300	0.7000	0.7700	87.9340	(80)
West	1.3000	26.0000	0.6300	0.7000	1.0000	13.4152	(82)

Solar gains	154.8842	303.1205	506.1364	759.1103	955.3847	990.6149	937.8242	787.6637	594.5803	360.9088	192.9863	127.5441	(83)
Total gains	592.8565	753.9890	937.5505	1178.5023	1353.3808	1375.4482	1308.1392	1157.1280	975.0590	752.5115	607.0621	555.4552	(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	19.6182	19.7166	19.8140	20.2847	20.3753	20.8077	20.8077	20.8898	20.6390	20.3753	20.1929	20.0057	
alpha	2.3079	2.3144	2.3209	2.3523	2.3584	2.3872	2.3872	2.3927	2.3759	2.3584	2.3462	2.3337	
util living area	0.9927	0.9868	0.9742	0.9414	0.8789	0.7762	0.6653	0.7240	0.8837	0.9673	0.9887	0.9938	(86)
MIT	17.1354	17.4527	18.0456	18.9130	19.7239	20.3875	20.7099	20.6314	20.0509	19.0001	17.9522	17.1271	(87)
Th 2	18.5044	18.5117	18.5188	18.5532	18.5598	18.5908	18.5908	18.5966	18.5787	18.5598	18.5465	18.5329	(88)
util rest of house	0.9897	0.9812	0.9623	0.9109	0.8050	0.6100	0.3762	0.4502	0.7736	0.9445	0.9829	0.9913	(89)
MIT 2	15.2979	15.6165	16.2063	17.0672	17.8202	18.3753	18.5539	18.5368	18.1492	17.1752	16.1337	15.3039	(90)
Living area fraction									fLA = Living area / (4) =			0.3761	(91)
MIT	15.9889	16.3071	16.8980	17.7613	18.5362	19.1321	19.3647	19.3245	18.8644	17.8615	16.8176	15.9896	(92)
Temperature adjustment												0.0000	
adjusted MIT	15.9889	16.3071	16.8980	17.7613	18.5362	19.1321	19.3647	19.3245	18.8644	17.8615	16.8176	15.9896	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9844	0.9730	0.9499	0.8965	0.8040	0.6577	0.4903	0.5564	0.7923	0.9339	0.9759	0.9867	(94)
Useful gains	583.5949	733.6150	890.5971	1056.4802	1088.1119	904.6884	641.3989	643.7795	772.5778	702.7668	592.4229	548.0612	(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	3303.9018	3208.1509	2909.9814	2422.3868	1860.4674	1207.7684	736.7862	776.3048	1280.0702	1976.2330	2668.5353	3267.8126	(97)
Space heating kWh	2023.9083	1662.8881	1502.4219	983.4528	574.6325	0.0000	0.0000	0.0000	0.0000	947.4589	1494.8009	2023.4950	(98a)
Space heating requirement - total per year (kWh/year)												11213.0583	
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	2023.9083	1662.8881	1502.4219	983.4528	574.6325	0.0000	0.0000	0.0000	0.0000	947.4589	1494.8009	2023.4950	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												11213.0583	
Space heating per m2											(98c) / (4) =	140.4265	(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	2505.0495	1972.0603	2017.3988	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5248	0.5967	0.5412	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1314.7635	1176.7066	1091.8889	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1547.7597	1472.1971	1300.6348	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	167.7572	219.8449	155.3069	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	41.9393	54.9612	38.8267	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												135.7273	(107)
Energy for space heating												140.4265	(99)
Energy for space cooling												1.6998	(108)
Total												142.1263	(109)
Fabric Energy Efficiency (DFEE)												142.1	(109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	79.8500	(1b)	x 3.0900	(2b) =	246.7365	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		246.7365	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1216	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3716	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3158	(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	0.4027	0.3948	0.3869	0.3474	0.3395	0.3001	0.3001	0.2922	0.3158	0.3395	0.3553	0.3711	(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	0.5811	0.5779	0.5749	0.5604	0.5576	0.5450	0.5450	0.5427	0.5499	0.5576	0.5631	0.5689	(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			1.7900	1.0000	1.7900			(26a)
TER Opening Type (Uw = 1.20)			17.3700	1.1450	19.8893			(27)
Opening			0.8000	1.5918	1.2734			(27a)
Heatloss Floor new			65.8900	0.1300	8.5657			(28a)
Heatloss Floor existing			17.1700	0.1300	2.2321			(28a)
External Wall Existing	33.7700		33.7700	0.1800	6.0786			(29a)
External Wall new	99.3400	17.3700	81.9700	0.1800	14.7546			(29a)
sheltered wall	16.5400	1.7900	14.7500	0.1800	2.6550			(29a)
External Roof 1	65.8900	0.8000	65.0900	0.1100	7.1599			(30)
External Roof existing	17.1700		17.1700	0.1100	1.8887			(30)
Total net area of external elements Aum(A, m2)			315.7700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2873			(33)
Party Wall 1			22.3700	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)							15.7885	(36)
Point Thermal bridges						(36a) =	0.0000	
Total fabric heat loss					(33) + (36) + (36a) =		82.0758	(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	47.3138	47.0575	46.8062	45.6258	45.4050	44.3769	44.3769	44.1866	44.7729	45.4050	45.8517	46.3188	(38)
Heat transfer coeff	129.3897	129.1333	128.8820	127.7016	127.4808	126.4528	126.4528	126.2624	126.8488	127.4808	127.9276	128.3946	(39)
Average = Sum(39)m / 12 =												127.7006	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6204	1.6172	1.6141	1.5993	1.5965	1.5836	1.5836	1.5812	1.5886	1.5965	1.6021	1.6079	(40)
HLP (average)												1.5993	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4600	(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	28.2757	27.8558	27.2644	26.1741	25.3576	24.4523	23.9633	24.5506	25.1899	26.1586	27.2714	28.1801	(42b)
Hot water usage for other uses	39.8230	38.3748	36.9267	35.4786	34.0305	32.5824	32.5824	34.0305	35.4786	36.9267	38.3748	39.8230	(42c)
Average daily hot water use (litres/day)												62.4187	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	68.0987	66.2306	64.1912	61.6527	59.3882	57.0348	56.5458	58.5811	60.6686	63.0854	65.6463	68.0031	(44)
Energy conte	107.8517	94.3116	98.6595	84.3995	79.9479	70.1309	68.3872	72.5356	74.8104	85.6063	93.5252	106.4764	(45)
Energy content (annual)											Total = Sum(45)m =	1036.6420	
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	91.6739	80.1648	83.8605	71.7396	67.9557	59.6113	58.1291	61.6553	63.5888	72.7653	79.4964	90.5049	(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	91.6739	80.1648	83.8605	71.7396	67.9557	59.6113	58.1291	61.6553	63.5888	72.7653	79.4964	90.5049	(64)
											Total per year (kWh/year) = Sum(64)m =	881.1457	(64)

12Total per year (kWh/year) 881 (64)

Electric shower(s)

	52.4273	46.7132	51.0090	48.6773	49.5907	47.3047	48.8815	49.5907	48.6773	51.0090	50.0498	52.4273 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 596.3578 (64a)

Heat gains from water heating, kWh/month

	36.0253	31.7195	33.7174	30.1042	29.3866	26.7290	26.7527	27.8115	28.0665	30.9436	32.3866	35.7331 (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	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	123.0004	(66)

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

	110.5243	122.3662	110.5243	114.2084	110.5243	114.2084	110.5243	110.5243	114.2084	110.5243	114.2084	110.5243	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	219.1268	221.4006	215.6706	203.4720	188.0735	173.6011	163.9327	161.6588	167.3889	179.5874	194.9859	209.4583	(68)

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

	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	35.3000	(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)

	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	-98.4004	(71)

Water heating gains (Table 5)

	48.4211	47.2016	45.3191	41.8114	39.4981	37.1236	35.9579	37.3810	38.9813	41.5908	44.9813	48.0283	(72)

Total internal gains

	437.9723	450.8686	431.4141	419.3920	397.9961	384.8333	370.3150	369.4643	380.4787	391.6027	414.0758	427.9110	(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	6.2300	10.6334	0.6300	0.7000	0.7700	20.2456	(74)
East	2.1200	19.6403	0.6300	0.7000	0.7700	12.7249	(76)
West	9.0200	19.6403	0.6300	0.7000	0.7700	54.1409	(80)
West	0.8000	26.0000	0.6300	0.7000	1.0000	8.2555	(82)

Solar gains	95.3670	186.6403	311.6417	467.4008	588.2476	609.9377	577.4344	484.9805	366.0979	222.2220	118.8276	78.5329	(83)
Total gains	533.3393	637.5089	743.0557	886.7928	986.2437	994.7710	947.7494	854.4448	746.5766	613.8246	532.9034	506.4440	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.8561	42.9412	43.0249	43.4226	43.4978	43.8515	43.8515	43.9176	43.7146	43.4978	43.3459	43.1882	
alpha	3.8571	3.8627	3.8683	3.8948	3.8999	3.9234	3.9234	3.9278	3.9143	3.8999	3.8897	3.8792	
util living area													
	0.9966	0.9928	0.9828	0.9475	0.8620	0.7077	0.5547	0.6236	0.8545	0.9727	0.9935	0.9972	(86)
MIT	18.9853	19.2108	19.5907	20.1252	20.5835	20.8690	20.9619	20.9403	20.7050	20.0953	19.4511	18.9530	(87)
Th 2	19.5984	19.6007	19.6030	19.6139	19.6159	19.6254	19.6254	19.6271	19.6217	19.6159	19.6118	19.6075	(88)
util rest of house													
	0.9953	0.9901	0.9762	0.9262	0.8049	0.5941	0.3967	0.4629	0.7703	0.9577	0.9907	0.9962	(89)
MIT 2	17.8072	18.0330	18.4105	18.9353	19.3486	19.5701	19.6172	19.6123	19.4659	18.9188	18.2813	17.7814	(90)
Living area fraction									fLA = Living area / (4) =			0.3761	(91)
MIT	18.2502	18.4760	18.8543	19.3828	19.8131	20.0586	20.1229	20.1117	19.9319	19.3612	18.7213	18.2220	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2502	18.4760	18.8543	19.3828	19.8131	20.0586	20.1229	20.1117	19.9319	19.3612	18.7213	18.2220	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9936	0.9871	0.9713	0.9217	0.8144	0.6332	0.4568	0.5238	0.7929	0.9539	0.9881	0.9947	(94)
Useful gains	529.9209	629.2983	721.7549	817.3446	803.1797	629.8958	432.9655	447.5555	591.9233	585.5377	526.5410	503.7820	(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													
	1805.0178	1753.1119	1592.2533	1338.6683	1034.2605	690.2515	445.4796	468.6471	739.7726	1116.8900	1486.6813	1800.3507	(97)
Space heating kWh													
	948.6721	755.2028	647.6508	375.3531	171.9241	0.0000	0.0000	0.0000	0.0000	395.3261	691.3010	964.6471	(98a)
Space heating requirement - total per year (kWh/year)												4950.0770	
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													
	948.6721	755.2028	647.6508	375.3531	171.9241	0.0000	0.0000	0.0000	0.0000	395.3261	691.3010	964.6471	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4950.0770	
Space heating per m2											(98c) / (4) =	61.9922	(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	1188.6560	935.7505	959.5941	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7686	0.8424	0.7939	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	913.5528	788.3161	761.8589	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1109.5133	1057.2945	952.1094	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	141.0915	200.1199	141.5464	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	35.2729	50.0300	35.3866	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling requirement	120.6895 (107)
Energy for space heating	61.9922 (99)
Energy for space cooling	1.5115 (108)
Total	63.5036 (109)
Fabric Energy Efficiency (TFEE)	63.5 (109)