

Energy Statement

Rear of Downhills Road

Job number: 12225

Date: July 2024

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Revision	Issue Date	Author	Checked	Description
1	11.07.2024	PK	AJ	First Issue

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1 Executive Summary

This report has been produced by Base Energy on behalf of Mr Theothosis Vassilou and in support of the planning application for the development named as land to the rear of 106 Downhills Park Road comprising the construction of one new detached house falling under the requirements of

It sets out the design approach with regards to energy, carbon dioxide emissions, and sustainability in order to ensure the development complies with:

- National Planning Policy
- The London Plan
- The London Borough of Haringey Local Plan Policy SP4

The above policies require:

- Zero Carbon over Part L 2021
- A 20 per cent contribution to energy demand from renewable technology

The design of the development will incorporate energy efficient building fabric and services in addition to low carbon technology:

- Thermal specification exceeding Part L 2021 notional U-values
- A design which limits air permeability, targeting 0.04
- A design which limits thermal bridging
- Energy saving building services including low energy lighting, heating controls
- Low carbon Air Source Heat Pumps and Solar PV Panels

Table 1.1: Carbon emissions summary

	Total CO2 Emission (kg CO2/year)	CO2 saving (kg CO2/year)	Percentage savings (%)
Part L Baseline	1.1	NA	N/A
Be Lean Design	0.9	0.1	11%
Be Clean	0.9	0.1	11%
Be Green	0.2	0.8	73%
Cumulative saving	NA	0.9	84%

This results in an 84% saving in CO2 emissions over Part L building regulations.

For the carbon off set contribution, please see the GLA spreadsheet provided. An EUI Calculation has not been included in this report and this could be reviewed once planning is granted with a more detailed analysis is carried out at technical design stage.

3 Planning Policy

National Planning Policy Framework 2023

The NPPF was updated in 2023 to place greater emphasis on beauty, place-making, the environment, and sustainable development. The strengthened environmental objectives aim to protect and enhance the natural, built, and historic environment, and encourage effective land use, greater biodiversity, prudent use of natural resources, minimisation of waste and pollution, and adaptation to climate change alongside a move to a low carbon economy.

The London Borough of Haringey Local Plan

Policy SP4 of the Local Plan 2013

The Local Plan requires all new development to be zero carbon from 2016 onwards. The council is proposing to keep this target and supporting it with a more comprehensive and ambitious set of policies designed to promote net zero on-site. The council has an ambition to be net zero carbon by 2041.

The Local Plan requires all developments were viable to reduce their CO2 emissions by 20% through use of on-site renewable energy.

The energy statement should follow the energy hierarchy Be Lean, Be Green of the London Plan which has recently been updated, London Plan SI 2 2021.

Based on the above, the proposed dwellings will aim to achieve zero carbon over Part L 2021 were feasible, of which 20% must be through the provision of renewable technologies were feasible. This report demonstrates how the development will meet Building Regulation requirements for energy efficiency (baseline scenario) and, through an assessment of energy efficiency measures and renewable technologies, demonstrates how the dwellings can achieve a higher saving in CO2 emissions over Part L 2021.

The dwelling will be assessed in line with Part L 2021 regulations using SAP 10.

4 Methodology

The Standard Assessment Procedure (SAP) is the UK Government methodology for assessing and calculating the energy performance of dwellings.

The Simplified Building Energy Model (SBEM) is the UK Government methodology for assessing and calculating the energy performance of non-domestic buildings.

SAP and SBEM calculations take into account a range of factors that contribute to energy efficiency, including:

- Materials used for the construction and the thermal insulation of the building fabric (u-values¹ and thermal mass)
- Air permeability
- Efficiency, fuel source, and control of heating and cooling systems
- Ventilation system energy use and heat recovery
- Lighting energy
- Low carbon and energy saving or generating technologies

Approved Document Part L of current Building Regulations addresses the conservation of fuel and power. Part L is divided into two separate documents:

- Part L1 Newly constructed and extended or renovated existing dwellings
- Part L2 Newly constructed and extended or renovated existing non-domestic buildings

To comply with Part L, the calculations should demonstrate how the building will either meet or achieve a percentage reduction in the Building Emission Rate (BER) under the required Target Emission Rate (TER).

The calculation software has been used to calculate a baseline of energy demand and carbon dioxide emissions as appropriate from which any reductions or contributions have been measured.

¹ U-values (Thermal Transmittance) - the measure of the overall rate of heat transfer by all mechanisms under standard conditions, through a particular section of a construction. Lower u-values mean better thermal insulation

5 Baseline Energy & CO2

Energy modelling software has been used to calculate a baseline for the development. This forms the basis from which compliance with planning policy has been measured.

Table 5.1: Baseline CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)
Baseline	12.56	85	1067.6

The **Total Baseline CO2 Emissions** for the development are shown to be 1067.6 kg/year.

6 Low Carbon Design – Fabric First – Be Lean

Before considering low carbon energy generating technology the development has been designed to reduce energy demand through the first step of the energy hierarchy by considering 'fabric first'. A thermally efficient building envelope will follow the design standards as set out below.

Table 6.0: Building Fabric Standards (including u-values W/m²K)

	Part L 2013 Limiting Parameters	Part L 2021 Limiting Parameters	Part L 2021 Notional Targets	Proposed Development
Walls	0.30	0.26	0.18	0.16
Ground Floor	0.25	0.18	0.13	0.11
Roof	0.20	0.16	0.11	0.13
Windows	2.00	1.6	1.2	1.2
Doors	2.00	1.6	1.0	1.0
Air permeability	10.00	8.00	5.00	5

- **Insulation:** The specified building envelope is designed to exceed the notional Part L targets and will help to limit the energy demand of the dwelling for space heating. Window u-value is proposed to be 1.0W/mk² and g-value is 0.5. Thermal mass is 250.
- **Thermal bridging:** The design will seek to limit heat loss through thermal bridging targeting a global 'y-value' of 0.04

Once heat retention has been addressed the next step is to ensure energy consuming building services are efficient.

- **Lighting:** Low energy LED lighting throughout with a minimum efficacy of 85 lumens per watt
- **Space & Water Heating:** Condensing gas boiler as per GLA requirements with an 89.5% efficiency boiler
- **Heating Controls:** Comprising time & temperature zone control
- **Ventilation:** Natural ventilation with localised extract fans

The specifications outlined above, and with the heating provided by a gas system as required by the GLA guidance, have been incorporated into the calculation to generate a dwelling emission rate to be measured against the baseline data.

Table 6.1: Baseline vs Be Lean CO2

	CO2 Emission Rate (kg CO2/m2/year)	Total Baseline Emissions (kg CO2/year)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	12.56	1068	1068	N/A
Be Lean	15.16	1,289 – 339	950	11%

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 40 kg/year.

7 Cooling hierarchy measures

The dwelling will incorporate cross ventilation to the top floor to allow air flow through the dwelling from the bedroom window opening across to the Ensuite room with roof light opening.

The rear living room and kitchen area has a large bifold opening to allow increased ventilation and a rear canopy to provide shading.

The window opening will have low g-values with a proposed g-value of 0.5.

8 Low Carbon Technology Review & Recommendations

Having set out an energy efficient design, the next step is to incorporate low carbon technology for energy generation. A number of technologies exist and should be specified where they:

- Comply with planning policy
- Are feasible for the site
- Are cost efficient
- Are appropriate for proposed development form and function
- Protect against fuel poverty
- Promote fuel security
- Reduce reliance on fossil fuels
- Reduce carbon emissions
- Reduce resource depletion
- Reduce pollution

Site location and development form and function will influence the suitability of different technologies through:

- Orientation
- Space (inside and outside of the buildings)
- Surrounding topography, structures, and natural features
- Wind speed
- Overshading
- Geology and ground conditions
- Building form, function, and density

In determining the most feasible renewable technologies for the dwelling, the following have been reviewed:

- Wind turbines
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Biomass
- Combined Heat and Power
- Photovoltaic Panels
- Solar water heating

WIND TURBINES

Wind turbines are used to produce electricity. They can be either pole mounted (in a suitably exposed position) or building mounted; building mounted systems need a sufficient wind speed at the structural height and both a structural survey and planning permission.

- Wind speed can be too low on low rise buildings
- Taller systems need sufficient space
- Wind resources very variable and unpredictable
- May need planning permission

Wind turbines technology is **not recommended** for this development

GROUND SOURCE HEAT PUMP (GSHP)

GSHPs use naturally occurring underground low-level heat in areas with appropriate geological features. Heat is transferred from the ground by either extracting and discharging (re-charging) water from/to the ground directly (open loop) or circulating water through pipes buried within the ground, (closed loop). The water is passed through a heat pump to transfer the heat from this water into a higher temperature water circuit to provide heating. The loop can be fitted horizontally (laid in a shallow trench) or vertically (in a borehole).

- Feasibility analysis is costly
- Suitable ground conditions required
- More capital intensive than air source heat pumps
- Can be more efficient and lower running costs than ASHPs
- Well suited to highly insulated buildings

Ground source heat pump technology is **not recommended** for this development

AIR SOURCE HEAT PUMP (ASHP)

ASHP systems absorb heat from outside air at a low temperature into a fluid which is then passed through an electrically driven compressor where its temperature is increased. There are two main types of ASHP systems: Air to Water systems distribute heat through wet central heating; Air to air produce warm air which is circulated by fans. For an ASHP system to be installed, there needs to be ample outdoor space for the external condensing unit; these units can also be noisy and blow out colder air to the neighbouring environment.

- Requires space for external plant and internal hot water tank for wet systems supplying DHW
- Can generate noise though quieter systems have been developed
- Least efficient when most needed
- Longer life than fossil fuel boilers
- High capital costs vs gas systems but lower than GSHPs
- Well suited to highly insulated buildings

Air source heat pump technology **is recommended** for this development

BIOMASS

Biomass systems burn wood pellets, chips, or logs to provide heat in a single room, or to power central heating and hot water boilers. There needs to be ample space available for both the boiler and the storage of fuel. There will also be regular deliveries of fuel and therefore adequate site access is required.

- Carbon emissions are cyclical unlike fossil fuel
- Requires fuel storage space and bulk delivery
- Carbon 'neutral' fuel in isolation but supply side emissions are still present so not neutral overall
- Harmful particulate emissions impact air quality and health

Biomass technology **is not recommended** for this development

COMBINED HEAT AND POWER (CHP)

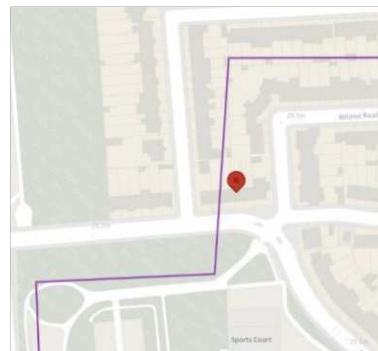
CHP is effectively an on-site small power plant providing both electrical power and thermal heat energy. It is an energy efficiency and low carbon measure rather than a renewable energy technology. A CHP system operates by burning a primary fuel (normally natural gas) by use of either a reciprocating engine or turbine, which in turn drives an alternator to generate electrical power. The heat emitted by the engine and exhaust gases is recovered and used to heat the building or to provide hot water.

- Reduces consumption of and reliance on grid electricity
- Works best with high and consistent heat and hot water demand
- Recovers waste energy
- Can export to the grid
- Uses fossil fuel
- Emissions on site rather than upstream
- Efficiency is sensitive to sizing

CHP **is not recommended** for this development

DISTRICT HEATING

District Heating systems provide multiple buildings or dwellings with heat and hot water from a central boiler house, or 'energy centre'. The system can provide heating or cooling which is transferred from the energy centre through a network of highly insulated pipes carrying the heated water to each dwelling.



- Economies of scale
- Frees up space in habitable areas of development
- Variety of systems
- Can make use of waste heat from industry
- Can be fossil fuel based and dependent

With reference to the Local Heat Map it has been determined that there are no existing heat networks or energy centres within a suitable radius from the development and there are no existing networks local to the site. However there is a proposed heat network, therefore the property should have the potential to connect to this in the future.

SOLAR PHOTOVOLTAIC (PV)

Solar PV cells (which are mounted together in panels or tiles on the roof) convert sunlight into electricity. The cells are made from layers of semi-conducting material; when the light shines on the cell, an electric field is created across the layers. Although PV cells are most effective in bright sunlight, they can still generate electricity on a cloudy day. The power of a PV cell is measured in kilowatts peak (kWp). Each PV panel produces 250 Watts to 420 Watts depending on the manufacture.

- Passive technology, requires no energy input from grid
- Does not require sunny days to generate power
- Capital costs can be high although payback is effective
- Needs sufficient roof space and orientation
- Zero site or upstream emissions
- Can export to the grid

Solar PV technology **is recommended** for this development.

SOLAR HOT WATER

Solar hot water systems absorb energy from the sun and transfer this energy using heat exchangers to heat water which can then be stored. Systems should be roof mounted and oriented to face between a south-east and south-west direction.

- Mostly passive technology but requires pump energy
- Not suitable for combi boilers and developments without roof space
- Lower CO2 reductions than other technologies

Solar hot water technology **is not recommended** for this development

Low Carbon Technology Summary

The low carbon technology review indicates that an ASHP and solar PV would potentially be feasible. The following low carbon technology is recommended:

ASHP and solar PV

In order to demonstrate how the dwellings can meet (or exceed) a saving in CO2 emissions, the be lean calculation (as detailed in Section 4 and Appendix A of this report) has been re-run with solar PV and an ASHP as the most feasible renewable energy solution. Due to the orientation and roof design, there are limitations on how many PV panels can be fitted to the property. The front of the proposed development will face in a Westerly direction and the rear of the house will face east and have space for 6 PV panels at 2.4kWp. A 2.4kWp PV system has been incorporated into the SAP calculation in an easterly direction. There is no space for PV on the front and side roofs due to dormer and roof lights. An ASHP has been included in the energy assessment for space heating and hot water with an efficiency of at least 300% air to water system.

Both these technologies are deemed optimal for meeting the needs of the development and achieving policy compliance. It has been incorporated into the energy model and the results are presented in the next section.

9 Low Carbon Technology – Renewable Energy Generation - Be Green

The selected Low Carbon Technology has been incorporated into the calculation and the results are set out below.

Table 8.1: Baseline vs Be Green CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	12.56	85	1068	N/A
Be Green Design	2.01	85	171	84%

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 897 kg/year.

10 Conclusion

Proposals are for the development named as land to the rear of Rear of 106 Downhills Park Road, London comprising a two bedroom detached new house.

Under the Haringey local planning Policy SP4 the proposed development is required to achieve zero carbon emissions over Part L building regulations were feasible.

Energy modelling software has been used to calculate a baseline against which compliance with the above can be measured.

The proposed development will be designed to limit energy demand through the inclusion of a thermally efficient building fabric and energy efficient services.

Low and zero carbon technology will be incorporated and is to comprise an ASHP and solar PV.

This results in 11% be lean saving, a 73% saving from low and zero carbon technology and a total 84% saving in CO2 over Part L 2021.

This Energy Statement and the calculations on which it is based demonstrate that the proposed development complies with the local planning policy requirements.

10 Appendix 1 – Be Green SAP Worksheet

Full SAP Calculation Printout



Property Reference	S11212_Copy 1		Issued on Date	12/07/2024
Assessment Reference	Be green	Prop Type Ref	Detached house	
Property	106 Downhills Park Road, Tottenham			

SAP Rating	89 B	DER	2.01	TER	12.56
Environmental	98 A	% DER < TER	84.00		
CO ₂ Emissions (t/year)	0.12	DFEE	44.37	TFEE	47.89
Compliance Check	See BREL	% DFEE < TFEE	7.35		
% DPER < TPER	56.35	DPER	28.75	TPER	65.86

Assessor Details	Mr. Peter Kinsella	Assessor ID	L770-0002
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

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	53.0000 (1b)	x 2.5500 (2b)	= 135.1500 (1b) - (3b)
First floor	31.9800 (1c)	x 2.3500 (2c)	= 75.1530 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.9800		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	210.3030 (5)

2. Ventilation rate

	m ³ 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1427 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3927 (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) = 0.3927 (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	0.5006	0.4908	0.4810	0.4319	0.4221	0.3730	0.3730	0.3632	0.3927	0.4221	0.4417	0.4614 (22b)
Effective ac	0.6253	0.6204	0.6157	0.5933	0.5891	0.5696	0.5696	0.5660	0.5771	0.5891	0.5976	0.6064 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Door			2.4700	1.0000	2.4700		(26)
Windows (Uw = 1.20)			21.2500	1.1450	24.3321		(27)
RL1-RL7			4.5500	1.0536	4.7941		(27a)
Heat Loss Floor 1			53.0000	0.1100	5.8300		(28a)
External Wall 1	115.1300	21.4600	93.6700	0.1600	14.9872		(29a)
stud walling	9.4400		9.4400	0.1800	1.6992		(29a)
dormer walling	7.3100	2.2600	5.0500	0.1800	0.9090		(29a)
Pitched roof	60.9700	4.5500	56.4200	0.1300	7.3346		(30)
void roof	15.0000		15.0000	0.1100	1.6500		(30)
dormer flat roof	3.6700		3.6700	0.1300	0.4771		(30)
flat roof	1.7100		1.7100	0.1300	0.2223		(30)
Total net area of external elements Aum(A, m ²)			266.2300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	64.7055		(33)
Party Floor 1			30.6800				(32d)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							13.3115 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	78.0170 (37)

Full SAP Calculation Printout



Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 43.3969	Feb 43.0592	Mar 42.7281	Apr 41.1733	May 40.8824	Jun 39.5283	Jul 39.5283	Aug 39.2775	Sep 40.0499	Oct 40.8824	Nov 41.4709	Dec 42.0862 (38)
Heat transfer coeff	121.4139	121.0762	120.7452	119.1904	118.8995	117.5453	117.5453	117.2945	118.0669	118.8995	119.4880	120.1032 (39)
Average = Sum(39)m / 12 =												119.1890

HLP	Jan 1.4287	Feb 1.4248	Mar 1.4209	Apr 1.4026	May 1.3991	Jun 1.3832	Jul 1.3832	Aug 1.3803	Sep 1.3893	Oct 1.3991	Nov 1.4061	Dec 1.4133 (40)
HLP (average)												1.4026
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.5506 (42)
Hot water usage for mixer showers	92.1041	90.7200	88.7030	84.8439	81.9960	78.8200	77.0148	79.0165	81.2107	84.6208	88.5628	91.7513 (42a)
Hot water usage for baths	28.9289	28.4993	27.8942	26.7787	25.9434	25.0172	24.5169	25.1177	25.7718	26.7629	27.9014	28.8311 (42b)
Hot water usage for other uses	40.7506	39.2688	37.7870	36.3051	34.8233	33.3414	33.3414	34.8233	36.3051	37.7870	39.2688	40.7506 (42c)
Average daily hot water use (litres/day)												148.7846 (43)

Daily hot water use	Jan 161.7837	Feb 158.4881	Mar 154.3842	Apr 147.9277	May 142.7627	Jun 137.1786	Jul 134.8731	Aug 138.9574	Sep 143.2877	Oct 149.1706	Nov 155.7330	Dec 161.3330 (44)
Energy conte	256.2258	225.6849	237.2828	202.5057	192.1860	168.6771	163.1173	172.0583	176.6880	202.4231	221.8702	252.6085 (45)
Energy content (annual)												Total = Sum(45)m = 2471.3277
Distribution loss (46)m = 0.15 x (45)m	38.4339	33.8527	35.5924	30.3759	28.8279	25.3016	24.4676	25.8087	26.5032	30.3635	33.2805	37.8913 (46)

Water storage loss:												150.0000 (47)
Store volume												1.8900 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												1.0206 (55)
Enter (49) or (54) in (55)												
Total storage loss	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386 (56)

If cylinder contains dedicated solar storage	31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)

Total heat required for water heating calculated for each month	311.1268	275.2729	292.1838	255.6357	247.0870	221.8071	218.0183	226.9593	229.8180	257.3241	275.0002	307.5095 (62)
WWHRS	-58.2576	-51.5235	-53.9524	-44.6748	-41.6353	-35.6276	-33.3952	-35.5124	-36.8617	-43.4559	-49.2302	-57.1788 (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	252.8692	223.7494	238.2314	210.9609	205.4517	186.1795	184.6231	191.4469	192.9563	213.8683	225.7700	250.3307 (64)
12Total per year (kWh/year)												2576.4374 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	129.1159	114.7106	122.8173	109.8371	107.8226	98.5891	98.1573	101.1302	101.2528	111.2265	116.2758	127.9131 (65)

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

Metabolic gains (Table 5), Watts	Jan 127.5298	Feb 127.5298	Mar 127.5298	Apr 127.5298	May 127.5298	Jun 127.5298	Jul 127.5298	Aug 127.5298	Sep 127.5298	Oct 127.5298	Nov 127.5298	Dec 127.5298 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	115.7733	128.1776	115.7733	119.6324	115.7733	119.6324	115.7733	115.7733	119.6324	115.7733	119.6324	115.7733 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.5336	231.9154	225.9132	213.1354	197.0056	181.8458	171.7182	169.3364	175.3385	188.1164	204.2462	219.4059 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530 (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)	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238 (71)
Water heating gains (Table 5)	173.5429	170.7003	165.0771	152.5516	144.9229	136.9294	131.9319	135.9277	140.6288	149.4980	161.4942	171.9262 (72)
Total internal gains	580.1087	592.0523	568.0226	546.5783	518.9607	499.6666	480.6823	482.2963	496.8587	514.6466	546.6318	568.3644 (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				2.3900	10.6334		0.5000		0.0000		0.7700		9.7843 (74)
East				7.8300	19.6403		0.5000		0.0000		0.7700		59.2066 (76)
South				3.6100	46.7521		0.5000		0.0000		0.7700		64.9784 (78)
West				7.4200	19.6403		0.5000		0.0000		0.7700		56.1063 (80)
South				4.5500	42.0754		0.6300		0.7000		1.0000		75.9837 (82)
Solar gains	266.0592	491.0727	754.7690	1045.1019	1249.9411	1270.1994	1212.8284	1059.2356	857.1424	566.7954	326.0052	222.7170	(83)
Total gains	846.1679	1083.1250	1322.7916	1591.6802	1768.9018	1769.8660	1693.5108	1541.5319	1354.0011	1081.4421	872.6370	791.0815	(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

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tau	48.6055	48.7411	48.8747	49.5123	49.6334	50.2052	50.2052	50.3126	49.9834	49.6334	49.3890	49.1360
alpha	4.2404	4.2494	4.2583	4.3008	4.3089	4.3470	4.3470	4.3542	4.3322	4.3089	4.2926	4.2757
util living area	0.9855	0.9617	0.9039	0.7693	0.5914	0.4191	0.3042	0.3476	0.5732	0.8617	0.9690	0.9888 (86)
Living	19.5670	19.9095	20.3327	20.7375	20.9280	20.9872	20.9975	20.9956	20.9535	20.6324	20.0174	19.5128
Non living	18.1319	18.5606	19.0716	19.5303	19.7135	19.7702	19.7756	19.7773	19.7461	19.4410	18.7121	18.0717
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.2669	19.9095	20.3327	20.7375	20.9280	20.9872	20.9975	20.9956	20.9535	20.6324	20.0174	19.7209 (87)
Th 2	19.7414	19.7444	19.7474	19.7614	19.7640	19.7762	19.7762	19.7785	19.7715	19.7640	19.7587	19.7531 (88)
util rest of house	0.9809	0.9503	0.8780	0.7195	0.5236	0.3416	0.2202	0.2566	0.4824	0.8147	0.9578	0.9852 (89)
MIT 2	19.0997	18.5606	19.0716	19.5303	19.7135	19.7702	19.7756	19.7773	19.7461	19.4410	18.7121	18.3747 (90)
Living area fraction									fLA = Living area / (4) =			0.2942 (91)
MIT	19.4431	18.9574	19.4426	19.8854	20.0708	20.1282	20.1351	20.1357	20.1013	19.7915	19.0961	18.7707 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4431	18.9574	19.4426	19.8854	20.0708	20.1282	20.1351	20.1357	20.1013	19.7915	19.0961	18.7707 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9796	0.9412	0.8707	0.7249	0.5410	0.3642	0.2450	0.2834	0.5077	0.8159	0.9499	0.9813 (94)
Useful gains	828.8676	1019.4832	1151.7185	1153.8185	956.9443	644.5151	414.8314	436.8618	687.4575	882.3229	828.9190	776.3154 (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	1838.5841	1702.0170	1562.7537	1309.3585	995.2787	649.8184	415.5298	438.1747	708.5511	1092.8655	1433.3872	1749.9901 (97)
Space heating kWh	751.2291	458.6627	305.8101	111.9888	28.5208	0.0000	0.0000	0.0000	0.0000	156.6437	435.2171	724.4140 (98a)
Space heating requirement - total per year (kWh/year)												2972.4863
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	751.2291	458.6627	305.8101	111.9888	28.5208	0.0000	0.0000	0.0000	0.0000	156.6437	435.2171	724.4140 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2972.4863
Space heating per m2										(98c) / (4) =		34.9787 (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 %)												302.8399 (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	751.2291	458.6627	305.8101	111.9888	28.5208	0.0000	0.0000	0.0000	0.0000	156.6437	435.2171	724.4140 (98)
Space heating efficiency (main heating system 1)	302.8399	302.8399	302.8399	302.8399	302.8399	0.0000	0.0000	0.0000	0.0000	302.8399	302.8399	302.8399 (210)
Space heating fuel (main heating system)	248.0615	151.4539	100.9808	36.9795	9.4178	0.0000	0.0000	0.0000	0.0000	51.7249	143.7120	239.2069 (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	252.8692	223.7494	238.2314	210.9609	205.4517	186.1795	184.6231	191.4469	192.9563	213.8683	225.7700	250.3307 (64)
Efficiency of water heater	177.1859	177.1859	177.1859	177.1859	177.1859	177.1859	177.1859	177.1859	177.1859	177.1859	177.1859	177.1859 (216)
Fuel for water heating, kWh/month	142.7140	126.2794	134.4528	119.0619	115.9526	105.0758	104.1974	108.0486	108.9005	120.7027	127.4198	141.2814 (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	28.5536	22.9068	20.6250	15.1108	11.6720	9.5361	10.6476	13.8401	17.9770	23.5868	26.6412	29.3472 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-30.1030	-48.5722	-79.8125	-97.8116	-110.2929	-104.2085	-102.3768	-93.1723	-76.5232	-57.8128	-34.4923	-25.0222 (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)	-7.9049	-20.8325	-52.9593	-99.0984	-147.8532	-155.2996	-151.3178	-118.8587	-76.0054	-34.9989	-11.8019	-5.9491 (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												981.5373 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												177.1859
Water heating fuel used												1454.0869 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												0.0000 (231)
Total electricity for the above, kWh/year												230.4442 (232)
Electricity for lighting (calculated in Appendix L)												
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1743.0801 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)

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Appendix Q - special features

Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	922.9883 (238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	981.5373	0.1573	154.3737 (261)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	1454.0869	0.1407	204.6171 (264)
Space and water heating			358.9908 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	230.4442	0.1443	33.2602 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-860.2004	0.1328	-114.2249
PV Unit electricity exported	-882.8797	0.1210	-106.8043
Total			-221.0292 (269)
Total CO ₂ , kg/year			171.2219 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.0100 (273)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	981.5373	1.5822	1552.9667 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	1454.0869	1.5203	2210.6735 (278)
Space and water heating			3763.6402 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	230.4442	1.5338	353.4630 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-860.2004	1.4907	-1282.2794
PV Unit electricity exported	-882.8797	0.4438	-391.8372
Total			-1674.1166 (283)
Total Primary energy kWh/year			2442.9866 (286)
Dwelling Primary energy Rate (DPER)			28.7500 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	53.0000 (1b)	x 2.5500 (2b)	= 135.1500 (1b) - (3b)
First floor	31.9800 (1c)	x 2.3500 (2c)	= 75.1530 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.9800		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	210.3030 (5)

2. Ventilation rate

	m ³ 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1427 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3927 (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) = 0.3927 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 4.7000 (22)
Wind factor	1.2750 1.2500 1.2250 1.1000 1.0750 0.9500 0.9250 1.0000 1.0750 1.1250 1.1750 (22a)
Adj infilt rate	0.5006 0.4908 0.4810 0.4319 0.4221 0.3730 0.3730 0.3632 0.3927 0.4221 0.4417 0.4614 (22b)
Effective ac	0.6253 0.6204 0.6157 0.5933 0.5891 0.5696 0.5696 0.5660 0.5771 0.5891 0.5976 0.6064 (25)

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3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K	
TER Opaque door			2.4700	1.0000	2.4700			(26)
TER Opening Type (Uw = 1.20)			15.4600	1.1450	17.7023			(27)
RL1-RL7			3.3100	1.5918	5.2687			(27a)
Heat Loss Floor 1			53.0000	0.1300	6.8900			(28a)
External Wall 1	115.1300	16.2900	98.8400	0.1800	17.7912			(29a)
stud walling	9.4400		9.4400	0.1800	1.6992			(29a)
dormer walling	7.3100	1.6400	5.6700	0.1800	1.0206			(29a)
Pitched roof	60.9700	3.3100	57.6600	0.1100	6.3426			(30)
void roof	15.0000		15.0000	0.1100	1.6500			(30)
dormer flat roof	3.6700		3.6700	0.1100	0.4037			(30)
flat roof	1.7100		1.7100	0.1100	0.1881			(30)
Total net area of external elements Aum(A, m ²)			266.2300					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	61.4264		(33)

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

250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	12.9500	0.0500	0.6475	
E3 Sill	11.9000	0.0500	0.5950	
E4 Jamb	36.4000	0.0500	1.8200	
E5 Ground floor (normal)	33.5000	0.1600	5.3600	
E6 Intermediate floor within a dwelling	23.6000	0.0000	0.0000	
E16 Corner (normal)	20.4000	0.0900	1.8360	
R1 Head of roof window	4.5500	0.0800	0.3640	
R2 Sill of roof window	4.5500	0.0600	0.2730	
E10 Eaves (insulation at ceiling level)	0.0000	0.0600	0.0000	
E11 Eaves (insulation at rafter level)	18.7500	0.0400	0.7500	
E13 Gable (insulation at rafter level)	24.8700	0.0800	1.9896	
E14 Flat roof	9.9800	0.0800	0.7984	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				14.4335 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	75.8599 (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	43.3969	43.0592	42.7281	41.1733	40.8824	39.5283	39.5283	39.2775	40.0499	40.8824	41.4709	42.0862	(38)
Average = Sum(39)m / 12 =	119.2568	118.9191	118.5881	117.0333	116.7424	115.3882	115.3882	115.1374	115.9098	116.7424	117.3308	117.0319	(39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.4034	1.3994	1.3955	1.3772	1.3738	1.3578	1.3578	1.3549	1.3640	1.3738	1.3807	1.3879	(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													2.5506 (42)
Hot water usage for mixer showers	66.9848	65.9782	64.5113	61.7047	59.6334	57.3236	56.0107	57.4665	59.0623	61.5424	64.4093	66.7282	(42a)
Hot water usage for baths	28.9289	28.4993	27.8942	26.7787	25.9434	25.0172	24.5169	25.1177	25.7718	26.7629	27.9014	28.8311	(42b)
Hot water usage for other uses	40.7506	39.2688	37.7870	36.3051	34.8233	33.3414	33.3414	34.8233	36.3051	37.7870	39.2688	40.7506	(42c)
Average daily hot water use (litres/day)													125.6255 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	136.6644	133.7462	130.1925	124.7885	120.4001	115.6823	113.8691	117.4075	121.1393	126.0922	131.5795	136.3099	(44)
Energy content (annual)	216.4430	190.4529	200.1010	170.8292	162.0817	142.2448	137.7148	145.3750	149.3768	171.1060	187.4591	213.4284	(45)
Distribution loss (46)m = 0.15 x (45)m	32.4664	28.5679	30.0152	25.6244	24.3123	21.3367	20.6572	21.8062	22.4065	25.6659	28.1189	32.0143	(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	263.0379	232.5386	246.6959	215.9210	208.6766	187.3367	184.3097	191.9699	194.4687	217.7009	232.5510	260.0233	(62)
WWHRS	-30.6227	-27.0829	-28.3597	-23.4829	-21.8853	-18.7274	-17.5539	-18.6668	-19.3761	-22.8422	-25.8775	-30.0556	(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	232.4152	205.4556	218.3362	192.4381	186.7913	168.6093	166.7557	173.3030	175.0926	194.8586	206.6735	229.9677	(64)
12Total per year (kWh/year)													2350.6970 (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	109.2432	96.9942	103.8095	92.8742	91.1681	83.3699	83.0661	85.6131	85.7413	94.1687	98.4036	108.2409	(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	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	127.5298	127.5298	127.5298	127.5298	127.5298	127.5298	127.5298	127.5298	127.5298	127.5298	127.5298	127.5298	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	115.7733	128.1776	115.7733	119.6324	115.7733	119.6324	115.7733	115.7733	119.6324	115.7733	119.6324	115.7733	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	229.5336	231.9154	225.9132	213.1354	197.0056	181.8458	171.7182	169.3364	175.3385	188.1164	204.2462	219.4059	(68)
	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	35.7530	(69)

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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)	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	-102.0238	(71)
Water heating gains (Table 5)	146.8323	144.3365	139.5289	128.9919	122.5378	115.7915	111.6480	115.0714	119.0851	126.5708	136.6717	145.4850 (72)
Total internal gains	556.3981	568.6885	545.4744	526.0186	499.5756	478.5287	460.3984	461.4400	475.3150	494.7195	524.8093	544.9232 (73)

6. Solar gains												

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		Specific data or Table 6c		FF	Access factor Table 6d	Gains W
North				1.7400	10.6334	0.6300		0.7000		0.7700		5.6545 (74)
East				5.7000	19.6403	0.6300		0.7000		0.7700		34.2132 (76)
South				2.6200	46.7521	0.6300		0.7000		0.7700		37.4347 (78)
West				5.4000	19.6403	0.6300		0.7000		0.7700		32.4125 (80)
South				3.3100	42.0754	0.6300		0.7000		1.0000		55.2760 (82)

Solar gains	164.9909	304.5711	468.1946	648.3578	775.4564	788.0246	752.4326	657.1370	531.7250	351.5586	202.1737	138.1072 (83)
Total gains	721.3890	873.2596	1013.6691	1174.3764	1275.0320	1266.5533	1212.8310	1118.5770	1007.0400	846.2781	726.9830	683.0305 (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	49.4847	49.6252	49.7638	50.4249	50.5505	51.1438	51.1438	51.2552	50.9136	50.5505	50.2970	50.0346
alpha	4.2990	4.3083	4.3176	4.3617	4.3700	4.4096	4.4096	4.4170	4.3942	4.3700	4.3531	4.3356
util living area	0.9919	0.9812	0.9554	0.8809	0.7432	0.5593	0.4133	0.4642	0.7107	0.9269	0.9833	0.9935 (86)
MIT	19.4613	19.7237	20.0931	20.5377	20.8326	20.9633	20.9922	20.9873	20.8980	20.4792	19.8911	19.4247 (87)
Th 2	19.7608	19.7638	19.7668	19.7809	19.7835	19.7958	19.7958	19.7981	19.7911	19.7835	19.7782	19.7726 (88)
util rest of house	0.9891	0.9752	0.9410	0.8449	0.6757	0.4640	0.3029	0.3476	0.6158	0.8958	0.9768	0.9913 (89)
MIT 2	18.0120	18.3455	18.8071	19.3437	19.6557	19.7773	19.7937	19.7943	19.7295	19.2952	18.5706	17.9735 (90)
Living area fraction	fLA = Living area / (4) = 0.2942 (91)											
MIT	18.4384	18.7510	19.1854	19.6950	20.0019	20.1262	20.1463	20.1452	20.0733	19.6435	18.9591	18.4005 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.4384	18.7510	19.1854	19.6950	20.0019	20.1262	20.1463	20.1452	20.0733	19.6435	18.9591	18.4005 (93)

8. Space heating requirement												

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9850	0.9684	0.9324	0.8419	0.6888	0.4910	0.3355	0.3820	0.6398	0.8914	0.9708	0.9878 (94)
Useful gains	710.5385	845.6551	945.1409	988.7467	878.2055	621.9170	406.9427	427.2606	644.2897	754.3782	705.7570	674.6819 (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	1686.0958	1647.1429	1504.3378	1263.3726	969.1886	637.6593	409.2005	431.2160	692.3614	1055.7583	1391.4327	1674.8894 (97)
Space heating kWh	725.8147	538.5998	416.0425	197.7307	67.6914	0.0000	0.0000	0.0000	0.0000	224.2268	493.6865	744.1544 (98a)
Space heating requirement - total per year (kWh/year)	3407.9467											
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	725.8147	538.5998	416.0425	197.7307	67.6914	0.0000	0.0000	0.0000	0.0000	224.2268	493.6865	744.1544 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	3407.9467											
Space heating per m2	(98c) / (4) = 40.1029 (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	725.8147	538.5998	416.0425	197.7307	67.6914	0.0000	0.0000	0.0000	0.0000	224.2268	493.6865	744.1544 (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)	786.3647	583.5317	450.7503	214.2261	73.3385	0.0000	0.0000	0.0000	0.0000	242.9326	534.8716	806.2344 (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	232.4152	205.4556	218.3362	192.4381	186.7913	168.6093	166.7557	173.3030	175.0926	194.8586	206.6735	229.9677 (64)
Efficiency of water heater (217)m	86.4356	86.1181	85.4819	84.1207	82.0109	79.8000	79.8000	79.8000	79.8000	84.3754	85.9398	79.8000 (216)
Fuel for water heating, kWh/month	268.8884	238.5744	255.4181	228.7643	227.7639	211.2898	208.9671	217.1717	219.4143	230.9424	240.4864	265.8679 (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	24.0554	19.2981	17.3758	12.7303	9.8332	8.0338	8.9702	11.6598	15.1449	19.8710	22.4442	24.7240 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-46.5433	-64.1223	-90.1028	-98.9701	-104.7967	-97.1279	-95.8930	-91.4255	-83.3103	-72.1698	-50.6206	-40.4146 (233a)

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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	-31.0591	-64.7230	-127.5359	-189.9875	-249.7386	-250.4107	-247.4880	-210.2388	-155.0087	-92.0601	-41.3002	-24.6100		(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													3692.2500	(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													2813.5487	(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)													194.1409	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-2619.6578	(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													4166.2818	(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	3692.2500	0.2100	775.3725	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2813.5487	0.2100	590.8452	(264)
Space and water heating			1366.2177	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	194.1409	0.1443	28.0205	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-935.4971	0.1351	-126.3671	
PV Unit electricity exported	-1684.1607	0.1261	-212.4359	
Total			-338.8030	(269)
Total CO2, kg/year			1067.3645	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.5600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3692.2500	1.1300	4172.2425	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2813.5487	1.1300	3179.3100	(278)
Space and water heating			7351.5525	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	194.1409	1.5338	297.7799	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-935.4971	1.4993	-1402.5541	
PV Unit electricity exported	-1684.1607	0.4630	-779.8043	
Total			-2182.3584	(283)
Total Primary energy kWh/year			5597.0748	(286)
Target Primary Energy Rate (TPER)			65.8600	(287)

11 Appendix 2 – Solar PV roof plan

