

Energy Statement for Planning

Client: Mr Theothosis Vassiliou

Site: Rear of 106 Downhills Park Road,
Tottenham,
London,
N17 6PA

Proposals: The construction of one new detached two bedroom house

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Report Details:

Prepared by	Date	Project	Revision
Peter Kinsella	29.02.23	11212	REVO

1 Introduction

This Energy Statement has been prepared in support of the planning application for the construction of one new detached two bedroom house on land to the rear of 106 Downhills Park Road, London.

National Planning Policy Framework 2021

The NPPF has been updated and meeting the challenge of climate change has taken a main focus of the new policy update. New developments should be planned and designed in ways to mitigate against climate change. With focus on locations of new developments, reduce emissions through use of location, orientation and design. Helping to increase the supply of renewable and low carbon energy sources.

The London Borough of Haringey Local Plan

Policy DM 21, 2017

The existing Local Plan (2017) requires all new development to be net zero carbon. 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 may need to achieve net zero carbon with a minimum 35% saving in CO2 emissions over Part L 2013, 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 2013.

Current Building Regulations and SAP 10

Part L of the Building Regulations has been updated and SAP 2012 is replaced by SAP 10. Under SAP 2012 electricity has a very high carbon factor however with the new SAP 10 the carbon factors for electricity have reduced and are now similar to gas. This is to reflect the increased influence of renewable energy technologies producing electricity for the national grid.

At the time of writing this report, we are still to follow the GLA Energy Assessment Guidance 2022.

This report is based on a Part L1 2021 and SAP 10 assessment, assumptions on the specifications have been made therefore the results of this report may vary when the assessment is carried out for building regulations.

2 Existing and Proposed Development

The site is located on land to the rear of 106 Downhills Park Road, London and the corner of Higham Road.

As previously detailed, proposals are for the construction of one new detached two bedroom house.

The proposed development will face in a westerly direction.

Given the scale and nature of the site (in particular the adjacent buildings situated in the terrace), this constrains the development proposals in terms of the layout, positioning and orientation of the proposed dwellings. Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).



Figure 1: Site Location

3 SAP 10 and Building Regulations (2021)

The Standard Assessment Procedure (SAP) 10 is the UK Government methodology for assessing and calculating the energy performance of dwellings.

The SAP calculation takes into account a range of factors that contribute to energy efficiency, including:

- Materials used for the construction of the dwelling and the thermal insulation of building fabric (u-values¹)
- Ventilation of the dwelling
- Efficiency and control of heating systems
- Fuel used to provide space heating,
- Lighting
- Heat recovery systems
- Renewable technologies

Approved Document Part L of current Building Regulations (2021) addresses the conservation of fuel and power. Part L is divided into four separate documents:

- Part L1 Newly Constructed Dwellings
- Part L1 Existing Dwellings
- Part L2 Newly Constructed Non - Dwellings
- Part L2 Existing Non - Dwellings

Part L1A sets out the minimum energy efficiency requirements for **new dwellings** and is based on the SAP methodology.

To comply with Part L1, the SAP calculation should demonstrate how the dwelling will either meet or achieve a percentage reduction in the Dwelling Emission Rate (DER) under the required Target Emission Rate (TER).

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

London Energy Plan

The London Plan 2021 energy policies (specifically Policy SI 2) requires an energy assessment for each planning application referable to the Mayor, setting out how the London Plan energy policies will be met within the development. Specifically, applicants are required to set out how the proposals apply the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

The hierarchy provides the mechanism through which the carbon dioxide (CO₂) emission reduction targets in Policy SI 2 of the London Plan are achieved. It also contributes to the implementation of strategic energy policies relating to decentralised networks and ensures opportunities for building occupants to receive efficient, secure and affordable energy.

The following will report will follow the steps in line with this energy hierarchy, with minimising energy demand via fabric improvements, then use energy more efficiently and use heat recovery systems, then the final step is to use renewable technology.

4 Baseline Scenario (Part L1 Compliance)

SAP modelling has been used to calculate the Building Regulations compliance threshold for the whole building. The Target Emission Rate forms the baseline from which any CO₂ emissions reductions can be measured. Simply complying with the minimum standards for building fabric and services would not usually be sufficient to ensure a 'pass' as the limiting values are designed to allow a degree of flexibility in achieving the main CO₂ limiting criterion. A sample of units has been modelled in full with numbers of each type and orientation being approximately proportionally representative of the whole.

Table 1: Baseline SAP Calculation Results – SAP 10

	Target Emission Rate (TER) (kg CO ₂ /m ² /year)	Floor Area (m ²)	Total Baseline Emissions (kg CO ₂ /year)
Development	12.08	93	1,123

The Baseline Target emission rate for the development assessed is shown to be 1123 (kg CO₂/m²/year)

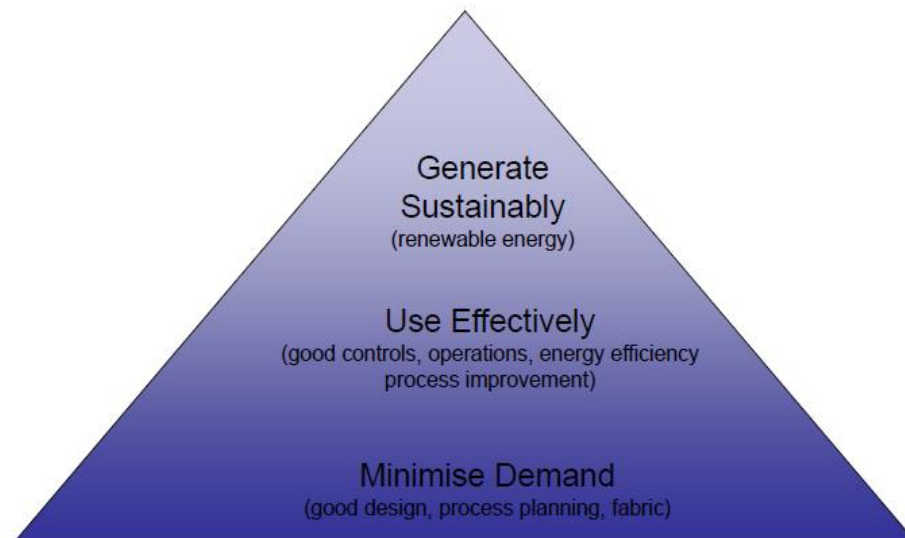
5 Be Lean Energy Efficiency Improvement Scenario

Be Lean Proposed Strategy

- Minimise demand
- Energy Efficient controls
- Generate energy

The Energy Hierarchy

Useful improvements can be made at all levels, but maximum benefits will be achieved if we focus first on minimising total energy requirements, then look at making better use of the energy we currently use, before thinking about how best to generate it.



In order to ensure that the development exceeds the minimum standards as set out in Part L1A, the following measures have been improved and are as proposed:

Table 3: Fabric Standards (u-values W/m²K)

	Part L1A Limiting Parameters	Notional Dwelling	Proposed Dwelling
Walls	0.30	0.18	0.16
Ground Floor	0.25	0.13	0.11
Roof	0.20	0.13	0.13
Windows	2.0	1.4	1.0
Air test	10	5	4
Ventilation	NA	Natural	Natural
Thermal Bridging	NA	0.05	0.05
Heating controls	NA	Time and temp zone, weather comp	Time and temp zone, delayed start thermostat
Lights	75%	100%	100%
Thermal mass	NA	Medium	medium

- 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
- Thermal bridging: The design will seek to limit heat loss through thermal bridging targeting a global 'y-value' of 0.05

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 90 lumens per watt
- Heating Controls: Comprising TRVs / time & temperature zone control
- Ventilation: Natural ventilation with localised extract fans

7 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:

- compliance 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)

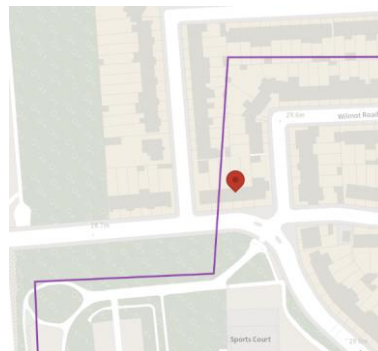
CHP is effectively an on-site small power plant providing both electrical power and thermal heat energy. It is an energy efficiency and low carbon measure rather than a renewable energy technology. A CHP system operates by burning a primary fuel (normally natural gas) by use of either a reciprocating 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 0.25Watts to 0.35Watts 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

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.

8 Low Carbon Technology – Renewable Energy Generation - Be Green

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 side of the house which faces south does not lend itself to more than 3 PV panels.

A 2.1kWp PV system has been incorporated into the SAP calculation split between south and easterly directions. 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.

The baseline measures and u-values have been used as the basis for this section, only implementing solar PV with an ASHP to improve on the baseline scenario.

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

	CO ₂ Emission Rate (kg CO ₂ /m ² /year)	Floor Area (m ²)	Total Baseline Emissions (kg CO ₂ /year)	Reduction in CO ₂
Baseline	12.08	93	1,123	N/A
Be Green Design	2.71	93	252.0	78%

The **CO₂ Emissions reduction** as a result of energy efficient fabric and services is shown to be 000 kg/year.

Table 8.2: Baseline vs Be Green Energy Demand

	Energy Demand (kWh/m ² /year)	Floor Area (m ²)	Reduction in Energy Demand
Baseline	63.21	93	N/A
Be Green Design	45.08	93	45%

The primary energy without solar PV is 52.68, this shows a difference of 14% saving in energy demand via renewable technologies.

9 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 local planning Policy DM 21, 2017 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 a 78% saving in CO₂ over Part L 2021 and 45% saving in primary energy, further carbon savings would be more difficult to limited space for solar PV panels.

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

Appendices

Appendix A Proposed Dwelling DER Worksheet

Full SAP Calculation Printout



Property Reference	S11212	Issued on Date	14/09/2023
Assessment Reference	v0	Prop Type Ref	Detached house
Property	106 Downhills Park Road, Tottenham		
SAP Rating	87 B	DER	2.61
Environmental	98 A	TER	12.08
CO ₂ Emissions (t/year)	0.19	% DER < TER	78.39
Compliance Check	See BREL	DFEE	44.69
% DPER < TPER	46.70	TFEE	45.02
		% DFEE < TFEE	0.74
		DPER	33.69
		TPER	63.21
Assessor Details	Mr. Peter Kinsella		Assessor ID
Client			L770-0002

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	50.0000 (1b)	x 2.5500 (2b)	= 127.5000 (1b) -
First floor	43.0000 (1c)	x 2.8000 (2c)	= 120.4000 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	247.9000 (5)

2. Ventilation rate

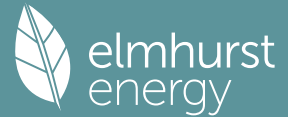
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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) =	Air changes per hour 30.0000 / (5) = 0.1210 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3710 (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) = 0.3154 (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	0.4021	0.3942	0.3863	0.3469	0.3390	0.2996	0.2996	0.2917	0.3154	0.3390	0.3548	0.3706 (22b)
Effective ac	0.5808	0.5777	0.5746	0.5602	0.5575	0.5449	0.5449	0.5425	0.5497	0.5575	0.5629	0.5687 (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			2.5300	1.0000	2.5300		(26)
Windows (Uw = 1.20)			31.8500	1.1450	36.4695		(27)
V11-13			1.0800	1.0536	1.1379		(27a)
Heat Loss Floor 1			50.0000	0.1100	5.5000		(28a)
External Wall 1	149.3000	34.3800	114.9200	0.1600	18.3872		(29a)
External Roof 1	43.0000		43.0000	0.1100	4.7300		(30)
Pitched roof	7.0000	1.0800	5.9200	0.1300	0.7696		(30)

Full SAP Calculation Printout



Rear gf 4.0000 4.0000 0.1100 0.4400 (30)
 Total net area of external elements Aum(A, m2) 253.3000 (31)
 Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 69.9642 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
 Thermal bridges (User defined value 0.050 * total exposed area) 12.6650 (36)
 Point Thermal bridges 0.0000 (36a) =
 Total fabric heat loss (33) + (36) + (36a) = 82.6292 (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	47.5166	47.2598	47.0081	45.8258	45.6046	44.5749	44.5749	44.3842	44.9715	45.6046	46.0521	46.5199 (38)
Heat transfer coeff	130.1458	129.8890	129.6373	128.4550	128.2338	127.2041	127.2041	127.0134	127.6007	128.2338	128.6813	129.1491 (39)
Average = Sum(39)m / 12 =												128.4540

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3994	1.3967	1.3939	1.3812	1.3789	1.3678	1.3678	1.3657	1.3721	1.3789	1.3837	1.3887 (40)
HLP (average)												1.3812
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6646 (42)
 Hot water usage for mixer showers 94.7324 93.3088 91.2342 87.2650 84.3358 81.0692 79.2125 81.2713 83.5281 87.0355 91.0900 94.3695 (42a)
 Hot water usage for baths 29.7509 29.3090 28.6868 27.5396 26.6806 25.7280 25.2135 25.8314 26.5041 27.5233 28.6942 29.6503 (42b)
 Hot water usage for other uses 41.9181 40.3938 38.8695 37.3453 35.8210 34.2967 34.2967 35.8210 37.3453 38.8695 40.3938 41.9181 (42c)
 Average daily hot water use (litres/day) 153.0313 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	166.4014	163.0117	158.7906	152.1499	146.8373	141.0939	138.7226	142.9236	147.3775	153.4284	160.1780	165.9379 (44)
Energy conte	263.5392	232.1264	244.0553	208.2855	197.6713	173.4914	167.7730	176.9693	181.7312	208.2009	228.2030	259.8187 (45)
Energy content (annual)												2541.8650
Distribution loss (46)m = 0.15 x (45)m	39.5309	34.8190	36.6083	31.2428	29.6507	26.0237	25.1659	26.5454	27.2597	31.2301	34.2304	38.9728 (46)
Water storage loss:												
Store volume												150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8900 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0206 (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												
Primary 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 (57)
Combi 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)
Total heat required for water heating calculated for each month	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)
WWHRS	318.4402	281.7144	298.9563	261.4155	252.5723	226.6214	222.6740	231.8703	234.8612	263.1019	281.3330	314.7197 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	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)
Total per year (kWh/year) = Sum(64)m =	318.4402	281.7144	298.9563	261.4155	252.5723	226.6214	222.6740	231.8703	234.8612	263.1019	281.3330	314.7197 (64)
12Total per year (kWh/year)												3188.2800 (64)
Electric shower(s)												3188 (64)
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 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)

Heat gains from water heating, kWh/month
 131.5476 116.8524 125.0692 111.7589 109.6465 100.1899 99.7053 102.7631 102.9296 113.1476 118.3815 130.3105 (65)

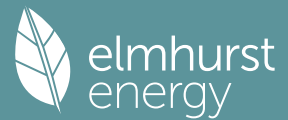
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299 (66)

 Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
 123.3171 136.5297 123.3171 127.4277 123.3171 127.4277 123.3171 123.3171 127.4277 123.3171 127.4277 123.3171 (67)
 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
 244.4900 247.0270 240.6338 227.0233 209.8424 193.6949 182.9074 180.3703 186.7636 200.3741 217.5549 233.7024 (68)
 Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 (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)
 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 (71)
 Water heating gains (Table 5)
 176.8113 173.8876 168.1037 155.2208 147.3743 139.1526 134.0125 138.1224 142.9578 152.0801 164.4187 175.1485 (72)
 Total internal gains
 607.5873 620.4132 595.0236 572.6407 543.5028 523.2442 503.2060 504.7788 520.1180 538.7402 572.3703 595.1370 (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
East				10.6100	19.6403		0.5000		0.0000		0.7700		80.2275 (76)
South				1.3800	46.7521		0.5000		0.0000		0.7700		24.8394 (78)
West				19.8600	19.6403		0.5000		0.0000		0.7700		150.1714 (80)
South				1.0800	42.0754		0.6300		0.7000		1.0000		18.0357 (82)
Solar gains	273.2740	524.7107	845.3312	1212.0857	1472.5831	1503.0513	1432.6868	1238.3048	975.6228	617.1564	338.8296	226.0252	(83)
Total gains	880.8613	1145.1239	1440.3548	1784.7263	2016.0859	2026.2955	1935.8927	1743.0836	1495.7408	1155.8967	911.1998	821.1622	(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	49.6238	49.7219	49.8185	50.2770	50.3637	50.7714	50.7714	50.8476	50.6136	50.3637	50.1886	50.0068
alpha	4.3083	4.3148	4.3212	4.3518	4.3576	4.3848	4.3848	4.3898	4.3742	4.3576	4.3459	4.3338
util living area	0.9878	0.9649	0.9023	0.7530	0.5654	0.3973	0.2882	0.3333	0.5633	0.8665	0.9731	0.9907 (86)
Living	19.5630	19.9121	20.3598	20.7674	20.9418	20.9900	20.9981	20.9964	20.9581	20.6326	20.0028	19.5019
Non living	18.1425	18.5798	19.1198	19.5745	19.7391	19.7835	19.7876	19.7887	19.7619	19.4551	18.7069	18.0710
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	20.2649	19.9121	20.3598	20.7674	20.9418	20.9900	20.9981	20.9964	20.9581	20.6326	20.0028	19.7115 (87)
Th 2	19.7638	19.7659	19.7680	19.7777	19.7796	19.7881	19.7881	19.7897	19.7848	19.7796	19.7759	19.7720 (88)
util rest of house	0.9838	0.9545	0.8764	0.7027	0.4998	0.3241	0.2093	0.2466	0.4742	0.8207	0.9632	0.9877 (89)
MIT 2	19.1174	18.5798	19.1198	19.5745	19.7391	19.7835	19.7876	19.7887	19.7619	19.4551	18.7069	18.3775 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	19.4506	18.9666	19.4798	19.9208	20.0883	20.1338	20.1391	20.1393	20.1092	19.7970	19.0832	18.7648 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4506	18.9666	19.4798	19.9208	20.0883	20.1338	20.1391	20.1393	20.1092	19.7970	19.0832	18.7648 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9826	0.9458	0.8693	0.7090	0.5169	0.3452	0.2322	0.2718	0.4988	0.8214	0.9558	0.9843 (94)
Useful gains	865.5069	1083.0076	1252.1319	1265.3430	1042.0222	699.4484	449.6059	473.7977	746.1105	949.4861	870.8907	808.2643 (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	1971.7809	1827.0956	1682.6678	1415.6768	1075.6627	703.9177	450.1825	474.9460	766.7794	1179.3609	1542.0081	1881.0320 (97)
Space heating kWh	823.0678	500.0271	320.3187	108.2403	25.0285	0.0000	0.0000	0.0000	0.0000	171.0269	483.2045	798.1391 (98a)
Space heating requirement - total per year (kWh/year)												3229.0530
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	823.0678	500.0271	320.3187	108.2403	25.0285	0.0000	0.0000	0.0000	0.0000	171.0269	483.2045	798.1391 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3229.0530
Space heating per m2										(98c) / (4) =		34.7210 (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 %)												303.4648 (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	823.0678	500.0271	320.3187	108.2403	25.0285	0.0000	0.0000	0.0000	0.0000	171.0269	483.2045	798.1391 (98)
Space heating efficiency (main heating system 1)	303.4648	303.4648	303.4648	303.4648	303.4648	0.0000	0.0000	0.0000	0.0000	303.4648	303.4648	303.4648 (210)
Space heating fuel (main heating system)	271.2235	164.7727	105.5538	35.6682	8.2476	0.0000	0.0000	0.0000	0.0000	56.3581	159.2292	263.0088 (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	318.4402	281.7144	298.9563	261.4155	252.5723	226.6214	222.6740	231.8703	234.8612	263.1019	281.3330	314.7197 (64)

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Efficiency of water heater													177.3586	(216)
(217)m	177.3586	177.3586	177.3586	177.3586	177.3586	177.3586	177.3586	177.3586	177.3586	177.3586	177.3586	177.3586	177.3586	(217)
Fuel for water heating, kWh/month														
	179.5460	158.8389	168.5604	147.3938	142.4077	127.7758	125.5502	130.7353	132.4217	148.3446	158.6238	177.4482	(219)	
Space cooling fuel requirement														
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	30.8769	24.7706	22.3032	16.3403	12.6217	10.3120	11.5139	14.9662	19.4397	25.5059	28.8089	31.7351	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-33.9427	-52.3487	-81.9465	-97.5872	-109.4132	-103.3720	-101.6592	-93.1945	-78.1058	-61.1972	-38.3678	-28.6389	(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	-8.9812	-21.8954	-50.8730	-88.7163	-127.2592	-131.8125	-129.3742	-104.4504	-70.7686	-35.5020	-13.0761	-6.9158	(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													1064.0618	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													177.3586	
Water heating fuel used													1797.6462	(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)													249.1945	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-1669.3982	(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													1441.5043	(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	1064.0618	0.1574	167.4908	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1797.6462	0.1410	253.4632	(264)
Space and water heating			420.9539	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	249.1945	0.1443	35.9665	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-879.7736	0.1333	-117.2838	
PV Unit electricity exported	-789.6246	0.1224	-96.6578	
Total			-213.9415	(269)
Total CO2, kg/year			242.9788	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.6100	(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	1064.0618	1.5826	1684.0355	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1797.6462	1.5214	2734.8701	(278)
Space and water heating			4418.9056	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	249.1945	1.5338	382.2228	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-879.7736	1.4926	-1313.1776	
PV Unit electricity exported	-789.6246	0.4492	-354.6774	
Total			-1667.8550	(283)
Total Primary energy kWh/year			3133.2734	(286)
Dwelling Primary energy Rate (DPER)			33.6900	(287)

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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	50.0000 (1b)	x 2.5500 (2b)	= 127.5000 (1b) -
First floor	43.0000 (1c)	x 2.8000 (2c)	= 120.4000 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	247.9000 (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) =	Air changes per hour 30.0000 / (5) = 0.1210 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3710 (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) = 0.3154 (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	0.4021	0.3942	0.3863	0.3469	0.3390	0.2996	0.2996	0.2917	0.3154	0.3390	0.3548	0.3706 (22b)
Effective ac	0.5808	0.5777	0.5746	0.5602	0.5575	0.5449	0.5449	0.5425	0.5497	0.5575	0.5629	0.5687 (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
TER Opaque door			2.5300	1.0000	2.5300		(26)
TER Opening Type (Uw = 1.20)			20.0300	1.1450	22.9351		(27)
V11-13			0.6800	1.5918	1.0824		(27a)
Heat Loss Floor 1			50.0000	0.1300	6.5000		(28a)
External Wall 1	149.3000	22.5600	126.7400	0.1800	22.8132		(29a)
External Roof 1	43.0000		43.0000	0.1100	4.7300		(30)
Pitched roof	7.0000	0.6800	6.3200	0.1100	0.6952		(30)
Rear gf	4.0000		4.0000	0.1100	0.4400		(30)
Total net area of external elements Aum(A, m ²)			253.3000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 61.7259		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 250.0000 (35)

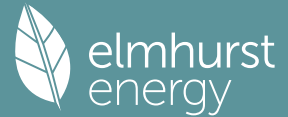
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	16.6000	0.0500	0.8300
E3 Sill	15.5000	0.0500	0.7750
E4 Jamb	40.0000	0.0500	2.0000
E5 Ground floor (normal)	30.0000	0.1600	4.8000
E6 Intermediate floor within a dwelling	28.0000	0.0000	0.0000
E16 Corner (normal)	10.7000	0.0900	0.9630
E18 Party wall between dwellings	10.7000	0.0600	0.6420
R1 Head of roof window	1.8000	0.0800	0.1440
R2 Sill of roof window	1.8000	0.0600	0.1080
R3 Jamb of roof window	3.6000	0.0800	0.2880
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.5500 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 72.2759 (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	47.5166	47.2598	47.0081	45.8258	45.6046	44.5749	44.5749	44.3842	44.9715	45.6046	46.0521	46.5199 (38)
Heat transfer coeff	119.7925	119.5357	119.2840	118.1017	117.8805	116.8508	116.8508	116.6601	117.2474	117.8805	118.3280	118.7958 (39)

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Average = Sum(39)m / 12 =												118.1007
HLP	Jan 1.2881	Feb 1.2853	Mar 1.2826	Apr 1.2699	May 1.2675	Jun 1.2565	Jul 1.2565	Aug 1.2544	Sep 1.2607	Oct 1.2675	Nov 1.2723	Dec 1.2774 (40) 1.2699
HLP (average)												
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												

Assumed occupancy												2.6646 (42)
Hot water usage for mixer showers												
68.8963	67.8609	66.3522	63.4655	61.3351	58.9594	57.6091	59.1064	60.7477	63.2985	66.2473	68.6323 (42a)	
Hot water usage for baths												
29.7509	29.3090	28.6868	27.5396	26.6806	25.7280	25.2135	25.8314	26.5041	27.5233	28.6942	29.6503 (42b)	
Hot water usage for other uses												
41.9181	40.3938	38.8695	37.3453	35.8210	34.2967	34.2967	35.8210	37.3453	38.8695	40.3938	41.9181 (42c)	
Average daily hot water use (litres/day)												129.2112 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	140.5653	137.5638	133.9086	128.3503	123.8366	118.9841	117.1192	120.7587	124.5971	129.6914	135.3353	140.2008 (44)
Energy conte	222.6211	195.8890	205.8125	175.7052	166.7079	146.3048	141.6456	149.5245	153.6407	175.9900	192.8100	219.5205 (45)
Energy content (annual)										Total = Sum(45)m =		2146.1718
Distribution loss (46)m = 0.15 x (45)m												
33.3932	29.3834	30.8719	26.3558	25.0062	21.9457	21.2468	22.4287	23.0461	26.3985	28.9215	32.9281 (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												
269.2160	237.9747	252.4074	220.7970	213.3028	191.3967	188.2405	196.1194	198.7325	222.5849	237.9018	266.1154 (62)	
WWHRS	-31.4965	-27.8558	-29.1690	-24.1531	-22.5098	-19.2618	-18.0548	-19.1995	-19.9290	-23.4941	-26.6159	-30.9132 (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												
237.7195	210.1190	223.2384	196.6439	190.7931	172.1349	170.1856	176.9199	178.8035	199.0909	211.2859	235.2022 (64)	
12Total per year (kWh/year)												
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												
111.2974	98.8017	105.7086	94.4954	92.7063	84.7198	84.3731	86.9928	87.1590	95.7926	100.1828	110.2665 (65)	

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

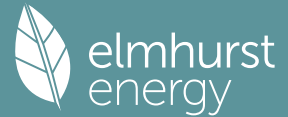
Metabolic gains (Table 5), Watts												
(66)m	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
123.3055	136.5168	123.3055	127.4156	123.3055	127.4156	123.3055	123.3055	127.4156	123.3055	127.4156	123.3055 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
244.4900	247.0270	240.6338	227.0233	209.8424	193.6949	182.9074	180.3703	186.7636	200.3741	217.5549	233.7024 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230 (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)												
-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839 (71)	
Water heating gains (Table 5)												
149.5933	147.0263	142.0814	131.2437	124.6053	117.6664	113.4047	116.9258	121.0542	128.7535	139.1428	148.2077 (72)	
Total internal gains												
583.3577	596.5390	571.9896	551.6515	523.7221	501.7459	482.5865	483.5706	498.2024	518.4020	550.0823	571.1845 (73)	

6. Solar gains												

[Jan]												
	Area											
	m2											
	Solar flux											
	Table 6a											
	W/m2											
	Specific data											
	or Table 6b											
	g											
	Specific data											
	or Table 6c											
	FF											
	Access											
	factor											
	Table 6d											
	Gains											
	W											
East	6.6700											40.0355 (76)
South	0.8700											12.4306 (78)
West	12.4900											74.9690 (80)
South	0.6800											11.3558 (82)

Solar gains	138.7908	266.3111	428.7046	614.3540	746.1966	761.5784	725.9472	627.5619	494.6513	313.1322	172.0501	114.8181 (83)

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Total gains 722.1486 862.8501 1000.6941 1166.0055 1269.9188 1263.3244 1208.5337 1111.1325 992.8537 831.5342 722.1324 686.0026 (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	53.9127	54.0285	54.1425	54.6845	54.7871	55.2699	55.2699	55.3602	55.0829	54.7871	54.5799	54.3650	
alpha	4.5942	4.6019	4.6095	4.6456	4.6525	4.6847	4.6847	4.6907	4.6722	4.6525	4.6387	4.6243	
util living area	0.9941	0.9861	0.9645	0.8952	0.7578	0.5701	0.4209	0.4746	0.7305	0.9405	0.9876	0.9953 (86)	
MIT	19.5578	19.7922	20.1397	20.5655	20.8488	20.9688	20.9939	20.9895	20.9054	20.4991	19.9496	19.5209 (87)	
Th 2	19.8502	19.8523	19.8545	19.8645	19.8664	19.8751	19.8751	19.8767	19.8717	19.8664	19.8626	19.8586 (88)	
util rest of house	0.9921	0.9816	0.9529	0.8631	0.6941	0.4791	0.3157	0.3630	0.6407	0.9146	0.9827	0.9937 (89)	
MIT 2	18.1962	18.4949	18.9311	19.4468	19.7488	19.8589	19.8734	19.8734	19.8129	19.3859	18.7043	18.1551 (90)	
Living area fraction									fLA = Living area / (4) =				0.2903 (91)
MIT	18.5915	18.8715	19.2819	19.7716	20.0682	20.1812	20.1987	20.1974	20.1301	19.7091	19.0659	18.5516 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.5915	18.8715	19.2819	19.7716	20.0682	20.1812	20.1987	20.1974	20.1301	19.7091	19.0659	18.5516 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9890	0.9763	0.9455	0.8601	0.7064	0.5047	0.3463	0.3955	0.6630	0.9102	0.9779	0.9911 (94)
Useful gains	714.1703	842.3751	946.1880	1002.8490	897.0102	637.5757	418.5513	439.4228	658.2457	756.8259	706.2013	679.8789 (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	1712.0165	1670.0963	1524.6817	1283.9563	986.4458	652.1640	420.5069	443.0086	707.0127	1073.7844	1415.8957	1704.9085 (97)
Space heating kWh	742.3976	556.2286	430.3993	202.3972	66.5401	0.0000	0.0000	0.0000	0.0000	235.8171	510.9799	762.6220 (98a)
Space heating requirement - total per year (kWh/year)												3507.3820
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	742.3976	556.2286	430.3993	202.3972	66.5401	0.0000	0.0000	0.0000	0.0000	235.8171	510.9799	762.6220 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3507.3820
Space heating per m2										(98c) / (4) =		37.7138 (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	742.3976	556.2286	430.3993	202.3972	66.5401	0.0000	0.0000	0.0000	0.0000	235.8171	510.9799	762.6220 (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)	804.3311	602.6312	466.3048	219.2820	72.0912	0.0000	0.0000	0.0000	0.0000	255.4899	553.6077	826.2427 (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	237.7195	210.1190	223.2384	196.6439	190.7931	172.1349	170.1856	176.9199	178.8035	199.0909	211.2859	235.2022 (64)
Efficiency of water heater	86.4356	86.1364	85.5064	84.1245	81.9476	79.8000	79.8000	79.8000	79.8000	84.4404	85.9639	79.8000 (216)
Fuel for water heating, kWh/month	275.0250	243.9374	261.0780	233.7534	232.8232	215.7079	213.2652	221.7041	224.0646	235.7767	245.7846	271.9087 (219)
Space cooling fuel requirement	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	25.6204	20.5537	18.5063	13.5585	10.4730	8.5565	9.5538	12.4184	16.1303	21.1638	23.9044	26.3325 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-45.2329	-62.9964	-89.4669	-99.3439	-106.0693	-98.6020	-97.3372	-92.3677	-83.4928	-71.3935	-49.4337	-39.1941 (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)	-27.9770	-58.5558	-115.8526	-173.2576	-228.3980	-229.2646	-226.6072	-192.2214	-141.3364	-83.5404	-37.2841	-22.1499 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												

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(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												3799.9805	(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												2874.8288	(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)												206.7716	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2471.3753	(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												4496.2057	(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	3799.9805	0.2100	797.9959 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2874.8288	0.2100	603.7140 (264)
Space and water heating			1401.7100 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	206.7716	0.1443	29.8435 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-934.9302	0.1349	-126.0787
PV Unit electricity exported	-1536.4450	0.1260	-193.6217
Total			-319.7004 (269)
Total CO2, kg/year			1123.7823 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.0800 (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	3799.9805	1.1300	4293.9780 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2874.8288	1.1300	3248.5565 (278)
Space and water heating			7542.5345 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	206.7716	1.5338	317.1532 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-934.9302	1.4984	-1400.9099
PV Unit electricity exported	-1536.4450	0.4626	-710.7330
Total			-2111.6429 (283)
Total Primary energy kWh/year			5878.1457 (286)
Target Primary Energy Rate (TPER)			63.2100 (287)