

Energy Statement

Collins Court,
Cascade Avenue,
London

Job number: S10559

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1 Executive Summary

This report has been produced by Base Energy on behalf of ROK Enterprises One and in support of the planning application for the development named as Collins Court comprising nine Dwellings, consisting of two runs of four new build terraces and one converted tennis pavilion to a detached bungalow, falling under the requirements of Haringey council.

The report 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 Policy SI 2: Minimising greenhouse gas emissions
- The Haringey Council Local Plan Policy SP4: Working Towards A Low Carbon Haringey

The above policies require:

- A minimum 35% CO2 reduction over Part L1 2021 with an aim to achieve zero Carbon
- A 10% CO2 reduction over Part L1 2021 through energy saving measures
- A 20% CO2 reduction from on-site renewable technology sources

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 4
- A design which limits thermal bridging, when the final construction has been decided these will be assessed
- Energy saving building services including low energy lighting, heating controls and heat recovery ventilation

Low carbon Air Source Heat Pumps and Solar PV Panels 3.2kWp for all the dwellings, totalling 28.8kWp for the total development and 5kw batteries in all plots. The flat roof space to all the new build dwellings has been maximised so a maximum 17% CO2 reduction of Part L1 2021 can be achieved.

This results in an 82% CO2 reduction Part L1 2021. With a total of 65% CO2 reduction through energy saving measures and 17% from the installation of on-site renewable technology.

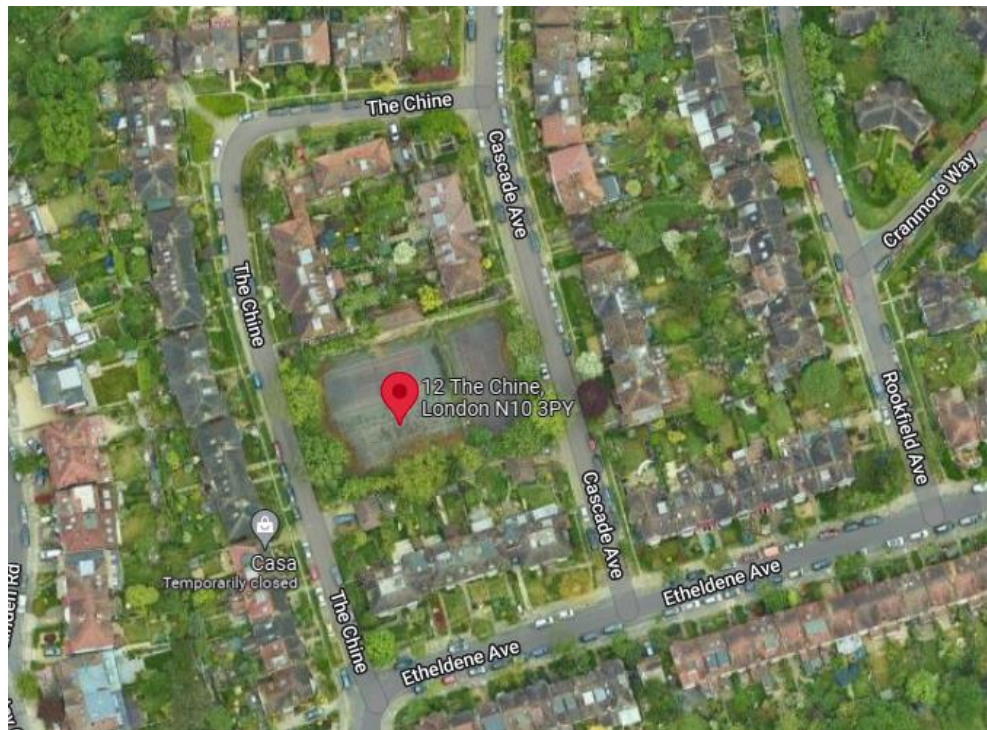
2 Existing and Proposed Development

The development site is located on land at Collins Court, Cascade Avenue in London.

The development proposals are for nine dwellings comprising of two runs of four new build terraces and one converted tennis pavilion to a detached bungalow. The development proposals constitute a minor development.

Aspects of the site location, shape, and surroundings (in particular the adjacent buildings), along with any other requirements of planning, use type, and scale will naturally constrain the development proposals in terms of the layout, positioning, and orientation of the proposed development. Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).

Figure 2.1: Site Location and proposals



3 Planning Policy

National Planning Policy Framework 2021

The NPPF was updated in July 2021 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.

Local Planning Policy

The Haringey Local Planning Policy requirements are as follows.

The development should target:

- Haringey Local plan - Policy SP4: Working Towards A Low Carbon Haringey
 - A 20% CO2 reduction from on-site renewable technology sources
- The London Plan Policy SI 2 Minimising greenhouse gas emissions
 - A minimum 35% CO2 reduction over Part L1 2021 with an aim to achieve zero carbon
 - A 10% CO2 reduction over Part L1 2021 through energy saving measures

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 – SAP 2012

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)
Baseline	10.90	1,840	20,096

The **Total Baseline CO2 Emissions** for the development are shown to be 20,096 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 with standards as set out below.

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

	Part L 2013 Limiting Parameters	Part L 2021 Notional Targets	Proposed Development (Existing)	Proposed Development (New Build)
Walls	0.30	0.18	0.18	0.17
Ground Floor	0.25	0.13	0.18	0.10
Roof	0.20	0.11	0.15	0.10
Windows	2.00	1.2	1.4	1.0
Doors	2.00	1.0	1.4	1.0
Air permeability	10.00	5.00	N/A	4.00

- Insulation: The specified building envelope is designed to meet or 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 and 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.

- Space & Water Heating: Air Source Heat Pump
- Heating Controls: Comprising time & temperature zone control
- Lighting: Low energy LED lighting throughout with a minimum efficacy of 80 lumens per watt
- Ventilation: Mechanical ventilation with heat recovery with an 88% efficiency and SFP 1.09
- Triple glazed windows with a u-value 1.0W/m²k, G value to be confirmed following the Part O assessment

Table 6.1: Baseline vs Be Lean CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	10.90	1,840	20,096	N/A
Be Lean (with notional PV savings included)	6.60	1,840	7,123	65%

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 12,973kg/year.

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 or proposed heat networks or energy centres within a suitable radius from the development and there are no existing networks local to the site

District heating **is not recommended** for this development

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 with solar PV would be potentially feasible. The following low carbon technology is recommended:

ASHP (winter efficiency 380% and Summer 176%) with Solar PV 3.2kWp for all the dwellings, totalling 28.8kWp for the total development and 5kw batteries in all plots. Due to the limited flat roof space each dwelling is planned to have 8 solar PV panels. When the Solar PV is being installed feasibility should be gained by a specialist installer.

This technology is 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

The ASHP and solar PV have been incorporated into the calculation and the results are set out below.

Table 8.1: Baseline vs Be Green CO2 – SAP 10

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area a (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	10.90	1,840	20,096	N/A
Lean & Green Design	2.0	1,840	3,496	-82%

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 16,600 kg/year.

The development shows a 17% saving in CO2 via renewable technology, however due to the roof layout it is not feasible to expand on the Be Green saving and every effort has been made to comply with the local planning policy with the target.

9 Zero Carbon Standard Summary

As previously detailed, this project falls under the London Plan's 2021 'Zero Carbon Policy' which states that major developments (10 dwellings or more) must achieve a minimum reduction of 35% in CO₂ emissions over Part L1 2021 Building Regulations with the view to achieving 'zero carbon'. The remaining amount of CO₂ is subject to a cash in lieu contribution which acts as the alternative to offsetting the zero carbon emissions.

Haringey Council have stipulated that their price is £95 per tonne of carbon charged over a 30-year period. With the specification, we have used to achieve the average 82% reduction in CO₂ emissions over the baseline, this leaves the following tonnes /year for the development.

Image 9.1 has been taken from the GLA spread sheet shows the total on site CO₂ reduction following the energy hierarchy with the required carbon off set payment.

Image 9.1 Carbon Off set payment

	Regulated residential carbon dioxide savings	
	Tonnes CO ₂ per annum	(%)
Be lean: savings from energy demand reduction	13.0	65%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	3.5	17%
Cumulative on site savings	16.5	82%
Annual savings from off-set payment	3.6	-
(Tonnes CO₂)		
Cumulative savings for off-set payment	109	-
Cash in-lieu contribution (£)	10,337	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development

However, it must be noted that this figure can change depending on the construction specifications, drawings, heating system type or fuel changes, all of which are decided at the Building Regulations design stage. Where SAP calculations will need to be undertaken after planning approval to determine the exact specification that will be incorporated. Only when this is carried out can a more accurate figure of the remaining tonnage of CO₂ be calculated. An 'As Built' SAP calculation and EPC will then be carried out at the post construction stage which will then state the exact amount of CO₂ emissions for each dwelling, in turn only then can the official cash contribution sum be determined.

This energy statement is to provide the feasibility of how the near zero carbon can be achieved with a minimum 35% reduction in CO₂ emissions, what will actually be used to achieve this figure will be decided by a combination of the SAP assessor and the client at building regulations stage.

10 Conclusion

Proposals are for the development named as Collins Court, Cascade Avenue comprising of nine dwellings, two runs of four new build terraces and one converted tennis pavilion to a detached bungalow falling under the requirements of Haringey Council.

- A minimum 35% CO2 reduction over Part L1 2021 with an aim to achieve zero carbon
- A 10% CO2 reduction over Part L1 2021 through energy saving measures
- A 20% CO2 reduction from on-site renewable technology sources

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 carbon technology will be incorporated and is to comprise an ASHP (winter efficiency 380% and Summer 176%) with Solar PV 3.2kWp for all the dwellings, totalling 28.8kWp for the total development with a 5kW battery in all plots.

This results in an 82% CO2 reduction over Part L1 2021. With a total of 65% CO2 reduction through energy saving measures and 17% for the installation of on-site renewable technology.

This Energy Statement and the calculations on which it is based demonstrate that the proposed development complies with the London plan.

11 Appendix 1 – Baseline/Be Lean SAP Worksheets

Full SAP Calculation Printout



Property Reference	S10559 02 03				Issued on Date	21/12/2023	
Assessment Reference	Be Lean			Prop Type Ref			
Property	Mid Terrace, The Grove, The Chine						
SAP Rating	76 C		DER	4.60		TER	10.63
Environmental	95 A		% DER < TER				56.73
CO ₂ Emissions (t/year)	0.95		DFEE	40.72		TFEE	42.08
Compliance Check	See BREL		% DFEE < TFEE				3.23
% DPER < TPER	14.89		DPER	47.94		TPER	56.33
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)
Basement floor	41.4500 (1a)	x 2.6500 (2a)	= 109.8425 (1a) - (3a)
Ground floor	61.9500 (1b)	x 3.0000 (2b)	= 185.8500 (1b) - (3b)
First floor	76.5400 (1c)	x 3.0000 (2c)	= 229.6200 (1c) - (3c)
Second floor	58.3300 (1d)	x 3.0500 (2d)	= 177.9065 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	238.2700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 703.2190 (5)

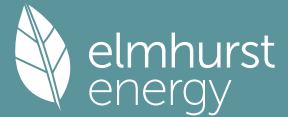
2. Ventilation rate

Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	4.0000 (17)	
Infiltration rate	0.2000 (18)	
Number of sides sheltered	2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	
Wind speed	Jan 5.1000	Feb 5.0000
Wind factor	1.2750	1.2500
Adj infilt rate	0.2167	0.2125
Balanced mechanical ventilation with heat recovery	0.2083	0.1870
If mechanical ventilation	0.1827	0.1615
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.1615	0.1615
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.1573	0.1573
Effective ac	0.3180	0.3180
	0.3307	0.3392
	0.3478	0.3478

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
Triple glazed windows (Uw = 1.00)			26.9300	0.9615	25.8942		(27)
Front door			2.2000	1.0000	2.2000		(26)
RL21			0.4500	1.3258	0.5966		(27a)
Heat Loss Floor 1			41.4500	0.1000	4.1450		(28)
Heat Loss Floor 2			22.4900	0.1000	2.2490		(28a)
Exposed floor			15.8000	0.1000	1.5800		(28b)
External Wall 1	157.7600	26.0800	131.6800	0.1700	22.3856		(29a)
Basement wall	23.8500		23.8500	0.1700	4.0545		(29a)
Dormer wall	5.3800	3.0500	2.3300	0.1700	0.3961		(29a)
External Roof 1	38.7800		38.7800	0.1000	3.8780		(30)
Pitched roof	58.5200	0.4500	58.0700	0.1000	5.8070		(30)
Bay window roof	1.2000		1.2000	0.1000	0.1200		(30)

Full SAP Calculation Printout



Total net area of external elements Aum(A, m2)	365.2300	(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	73.3060 (33)
Party Wall 1	172.0700 0.0000 0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.089 * total exposed area)	32.5055	(36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	105.8115 (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	84.6447	83.6584	82.6722	77.7409	76.7546	71.8233	71.8233	70.8370	73.7958	76.7546	78.7271	80.6997
Average = Sum(39)m / 12 =	190.4562	189.4699	188.4837	183.5524	182.5661	177.6348	177.6348	176.6485	179.6073	182.5661	184.5386	186.5111
												183.3058
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.7993	0.7952	0.7911	0.7704	0.7662	0.7455	0.7455	0.7414	0.7538	0.7662	0.7745	0.7828
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0517 (42)
Hot water usage for mixer showers													
	103.6565	102.0987	99.8288	95.4856	92.2805	88.7062	86.6745	88.9273	91.3967	95.2345	99.6709	103.2593	(42a)
Hot water usage for baths													
	32.5419	32.0586	31.3780	30.1232	29.1835	28.1416	27.5789	28.2547	28.9905	30.1054	31.3861	32.4319	(42b)
Hot water usage for other uses													
	45.8823	44.2138	42.5454	40.8769	39.2085	37.5400	37.5400	39.2085	40.8769	42.5454	44.2138	45.8823	(42c)
Average daily hot water use (litres/day)													167.4504 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	182.0806	178.3712	173.7522	166.4857	160.6725	154.3878	151.7934	156.3904	161.2642	167.8852	175.2708	181.5735	(44)
Energy conte	288.3712	253.9981	267.0506	227.9106	216.2961	189.8378	183.5810	193.6440	198.8549	227.8187	249.7054	284.3002	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)m													
	43.2557	38.0997	40.0576	34.1866	32.4444	28.4757	27.5371	29.0466	29.8282	34.1728	37.4558	42.6450	(46)
Water storage loss:													
Store volume													200.0000 (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													
	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													
	343.2722	303.5861	321.9516	281.0406	271.1971	242.9678	238.4820	248.5450	251.9849	282.7197	302.8354	339.2012	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	343.2722	303.5861	321.9516	281.0406	271.1971	242.9678	238.4820	248.5450	251.9849	282.7197	302.8354	339.2012	(64)
12Total per year (kWh/year)													
Electric shower(s)													3427.7837 (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	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month													
	139.8042	124.1248	132.7151	118.2843	115.8392	105.6251	104.9615	108.3074	108.6232	119.6705	125.5311	138.4506	(65)

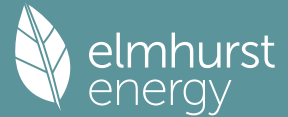
5. Internal gains (see Table 5 and 5a)

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													
	235.9462	261.2261	235.9462	243.8110	235.9462	243.8110	235.9462	235.9462	243.8110	235.9462	243.8110	235.9462	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	406.1044	410.3185	399.6991	377.0917	348.5540	321.7325	303.8141	299.6000	310.2193	332.8267	361.3645	388.1860	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	(71)
Water heating gains (Table 5)													
	187.9089	184.7095	178.3806	164.2837	155.6979	146.7015	141.0772	145.5745	150.8656	160.8475	174.3487	186.0895	(72)
Total internal gains													
	901.7347	928.0293	885.8011	856.9617	811.9732	781.0202	749.6127	749.8958	773.6712	801.3956	851.2995	881.9969	(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
East				15.3000	19.6403		0.5700		0.7000		0.7700		83.0893 (76)
Southwest				1.0000	36.7938		0.5700		0.7000		0.7700		10.1738 (79)
West				9.6300	19.6403		0.5700		0.7000		0.7700		52.2974 (80)
Northwest				1.0000	11.2829		0.5700		0.7000		0.7700		3.1198 (81)
West				0.4500	25.5349		0.6300		0.7000		1.0000		4.5607 (82)
Solar gains	153.2408	297.6216	486.7433	707.5110	866.8690	887.7430	844.9948	725.6496	565.0680	352.0850	190.6402	126.3206	(83)
Total gains	1054.9755	1225.6509	1372.5443	1564.4727	1678.8422	1668.7632	1594.6075	1475.5454	1338.7391	1153.4805	1041.9397	1008.3175	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	86.8784	87.3306	87.7876	90.1461	90.6331	93.1492	93.1492	93.6692	92.1261	90.6331	89.6643	88.7160	21.0000 (85)
alpha	6.7919	6.8220	6.8525	7.0097	7.0422	7.2099	7.2099	7.2446	7.1417	7.0422	6.9776	6.9144	
util living area	0.9996	0.9988	0.9955	0.9730	0.8805	0.6670	0.4887	0.5474	0.8408	0.9880	0.9989	0.9997	(86)
MIT	20.1879	20.2956	20.4613	20.7024	20.8762	20.9482	20.9560	20.9553	20.9151	20.6805	20.4033	20.1865	(87)
Th 2	20.2539	20.2575	20.2611	20.2791	20.2827	20.3008	20.3008	20.3044	20.2936	20.2827	20.2755	20.2683	(88)
util rest of house	0.9995	0.9984	0.9939	0.9633	0.8434	0.6002	0.4119	0.4664	0.7829	0.9822	0.9985	0.9996	(89)
MIT 2	19.2775	19.4186	19.6333	19.9516	20.1558	20.2403	20.2451	20.2486	20.2076	19.9306	19.5718	19.2877	(90)
Living area fraction									FLA = Living area / (4) =			0.1016	(91)
MIT	19.3700	19.5077	19.7174	20.0279	20.2290	20.3122	20.3174	20.3204	20.2795	20.0068	19.6563	19.3790	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3700	19.5077	19.7174	20.0279	20.2290	20.3122	20.3174	20.3204	20.2795	20.0068	19.6563	19.3790	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9993	0.9978	0.9924	0.9591	0.8403	0.6013	0.4137	0.4683	0.7816	0.9792	0.9979	0.9995	(94)
Useful gains	1054.2304	1223.0100	1362.0779	1500.4205	1410.7795	1003.4894	659.6625	691.0042	1046.3406	1129.5393	1039.7658	1007.8017	(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	2870.1795	2767.7160	2491.2692	2042.5538	1557.1061	1014.6874	660.3344	692.5395	1109.8888	1717.3562	2317.1207	2831.0558	(97)
Space heating kWh	1351.0661	1038.0425	840.1183	390.3360	108.8670	0.0000	0.0000	0.0000	0.0000	437.3358	919.6955	1356.5010	(98a)
Space heating requirement - total per year (kWh/year)												6441.9621	
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	1351.0661	1038.0425	840.1183	390.3360	108.8670	0.0000	0.0000	0.0000	0.0000	437.3358	919.6955	1356.5010	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6441.9621	
Space heating per m2										(98c) / (4) =		27.0364	(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 %)												170.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	1351.0661	1038.0425	840.1183	390.3360	108.8670	0.0000	0.0000	0.0000	0.0000	437.3358	919.6955	1356.5010	(98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)	794.7448	610.6132	494.1872	229.6094	64.0394	0.0000	0.0000	0.0000	0.0000	257.2563	540.9974	797.9418	(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	343.2722	303.5861	321.9516	281.0406	271.1971	242.9678	238.4820	248.5450	251.9849	282.7197	302.8354	339.2012	(64)
Efficiency of water heater	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(216)
Fuel for water heating, kWh/month	201.9248	178.5801	189.3833	165.3180	159.5277	142.9223	140.2835	146.2030	148.2264	166.3057	178.1385	199.5301	(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	87.3652	78.9105	87.3652	84.5470	87.3652	84.5470	87.3652	87.3652	84.5470	87.3652	84.5470	87.3652	(231)
Lighting	66.4460	53.3054	47.9956	35.1637	27.1614	22.1911	24.7776	32.2068	41.8335	54.8878	61.9956	68.2927	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3789.3895	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.0000	
Water heating fuel used												2016.3433	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 1.1990)													
mechanical ventilation fans (SFP = 1.1990)													1028.6547 (230a)
Total electricity for the above, kWh/year													1028.6547 (231)
Electricity for lighting (calculated in Appendix L)													536.2572 (232)

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Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	7370.6447 (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	3789.3895	0.1559	590.8815 (261)
Total CO2 associated with community systems			0.0000 (273)
Water heating (other fuel)	2016.3433	0.1410	284.3807 (264)
Space and water heating			875.2622 (265)
Pumps, fans and electric keep-hot	1028.6547	0.1387	142.6871 (267)
Energy for lighting	536.2572	0.1443	77.3985 (268)
Total CO2, kg/year			1095.3478 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.6000 (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	3789.3895	1.5773	5976.9886 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2016.3433	1.5215	3067.8943 (278)
Space and water heating			9044.8829 (279)
Pumps, fans and electric keep-hot	1028.6547	1.5128	1556.1488 (281)
Energy for lighting	536.2572	1.5338	822.5291 (282)
Total Primary energy kWh/year			11423.5608 (286)
Dwelling Primary energy Rate (DPER)			47.9400 (287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Basement floor	41.4500 (1a)	x 2.6500 (2a)	= 109.8425 (1a) - (3a)
Ground floor	61.9500 (1b)	x 3.0000 (2b)	= 185.8500 (1b) - (3b)
First floor	76.5400 (1c)	x 3.0000 (2c)	= 229.6200 (1c) - (3c)
Second floor	58.3300 (1d)	x 3.0500 (2d)	= 177.9065 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	238.2700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	703.2190 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0569 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3069 (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) = 0.2608 (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	0.3326	0.3261	0.3195	0.2869	0.2804	0.2478	0.2478	0.2413	0.2608	0.2804	0.2935	0.3065 (22b)
Effective ac	0.5553	0.5532	0.5511	0.5412	0.5393	0.5307	0.5307	0.5291	0.5340	0.5393	0.5431	0.5470 (25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K
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	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.2000	1.0000	2.2000			(26)
TER Opening Type (Uw = 1.20)			26.9300	1.1450	30.8359			(27)
RL21			0.4500	1.4151	0.6368			(27a)
Heat Loss Floor 1			41.4500	0.1300	5.3885			(28)
Heat Loss Floor 2			22.4900	0.1300	2.9237			(28a)
Exposed floor			15.8000	0.1300	2.0540			(28b)
External Wall 1	157.7600	26.0800	131.6800	0.1800	23.7024			(29a)
Basement wall	23.8500		23.8500	0.1800	4.2930			(29a)
Dormer wall	5.3800	3.0500	2.3300	0.1800	0.4194			(29a)
External Roof 1	38.7800		38.7800	0.1100	4.2658			(30)
Pitched roof	58.5200	0.4500	58.0700	0.1100	6.3877			(30)
Bay window roof	1.2000		1.2000	0.1100	0.1320			(30)
Total net area of external elements Aum(A, m2)			365.2300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	83.2392			(33)
Party Wall 1			172.0700	0.0000	0.0000			(32)

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

	Length	Psi-value	Total
K1 Element	18.1100	0.0500	0.9055
E2 Other lintels (including other steel lintels)	17.1100	0.0500	0.8555
E3 Sill	51.1200	0.0500	2.5560
E4 Jamb	22.6100	0.1600	3.6176
E5 Ground floor (normal)	5.4900	0.3200	1.7568
E20 Exposed floor (normal)	12.4900	0.3200	3.9968
E21 Exposed floor (inverted)	9.0000	0.0700	0.6300
E22 Basement floor	38.1700	0.0000	0.0000
E6 Intermediate floor within a dwelling	18.6000	0.0400	0.7440
E11 Eaves (insulation at rafter level)	5.4400	0.0800	0.4352
E13 Gable (insulation at rafter level)	22.7800	0.0800	1.8224
E14 Flat roof	41.7200	0.0900	3.7548
E16 Corner (normal)	18.3500	-0.0900	-1.6515
E17 Corner (inverted - internal area greater than external area)	24.3500	0.0600	1.4610
E18 Party wall between dwellings	19.2800	0.0800	1.5424
P1 Party wall - Ground floor	51.7200	0.0000	0.0000
P2 Party wall - Intermediate floor within a dwelling	12.7800	0.1200	1.5336
P4 Party wall - Roof (insulation at ceiling level)	15.2500	0.0800	1.2200
P5 Party wall - Roof (insulation at rafter level)	0.5500	0.0800	0.0440
R1 Head of roof window	0.5500	0.0600	0.0330
R2 Sill of roof window	1.6400	0.0800	0.1312
R3 Jamb of roof window	10.7100	0.0800	0.8568
R4 Ridge (vaulted ceiling)	21.6500	0.0400	0.8660
R5 Ridge (inverted)			

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 27.1111 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 110.3503 (37)

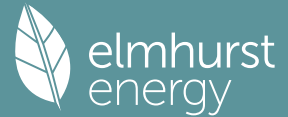
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	128.8655	128.3671	127.8786	125.5841	125.1548	123.1564	123.1564	122.7863	123.9262	125.1548	126.0233	126.9312	(38)
Heat transfer coeff	239.2157	238.7174	238.2289	235.9344	235.5051	233.5067	233.5067	233.1366	234.2764	235.5051	236.3735	237.2815	(39)
Average = Sum(39)m / 12 =												235.9323	
HLP	1.0040	1.0019	0.9998	0.9902	0.9884	0.9800	0.9800	0.9785	0.9832	0.9884	0.9920	0.9959	(40)
HLP (average)												0.9902	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0517 (42)
Hot water usage for mixer showers	75.3865	74.2536	72.6027	69.4441	67.1131	64.5136	63.0360	64.6744	66.4704	69.2614	72.4879	75.0977	(42a)
Hot water usage for baths	32.5419	32.0586	31.3780	30.1232	29.1835	28.1416	27.5789	28.2547	28.9905	30.1054	31.3861	32.4319	(42b)
Hot water usage for other uses	45.8823	44.2138	42.5454	40.8769	39.2085	37.5400	37.5400	39.2085	40.8769	42.5454	44.2138	45.8823	(42c)
Average daily hot water use (litres/day)												141.3865	(43)
Daily hot water use	153.8107	150.5260	146.5261	140.4442	135.5051	130.1952	128.1549	132.1375	136.3378	141.9122	148.0879	153.4118	(44)
Energy conte	243.5985	214.3471	225.2052	192.2611	182.4159	160.0902	154.9922	163.6139	168.1181	192.5735	210.9783	240.2059	(45)
Energy content (annual)										Total = Sum(45)m =		2348.4000	
Distribution loss (46)m = 0.15 x (45)m	36.5398	32.1521	33.7808	28.8392	27.3624	24.0135	23.2488	24.5421	25.2177	28.8860	31.6467	36.0309	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	294.5246	260.3448	276.1313	241.5444	233.3420	209.3735	205.9183	214.5399	217.4014	243.4996	260.2616	291.1319	(62)
WWHRS	-34.4636	-30.4799	-31.9168	-26.4283	-24.6303	-21.0763	-19.7557	-21.0082	-21.8063	-25.7073	-29.1232	-33.8254	(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	260.0610	229.8650	244.2145	215.1160	208.7117	188.2972	186.1626	193.5318	195.5951	217.7923	231.1384	257.3066	(64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				2627.7923	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	121.7374	108.0686	115.6216	103.3534	101.3941	92.6566	92.2758	95.1425	95.3259	104.7716	109.5769	120.6093	(65)

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

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Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	229.3724	253.9480	229.3724	237.0182	229.3724	237.0182	229.3724	229.3724	237.0182	229.3724	237.0182	229.3724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	406.1044	410.3185	399.6991	377.0917	348.5540	321.7325	303.8141	299.6000	310.2193	332.8267	361.3645	388.1860 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672 (71)
Water heating gains (Table 5)												
	163.6255	160.8164	155.4054	143.5464	136.2825	128.6898	124.0266	127.8797	132.3971	140.8220	152.1902	162.1093 (72)
Total internal gains												
	870.8776	896.8581	856.2521	829.4316	785.9840	756.2156	725.9883	725.6273	748.4098	774.7964	822.3481	851.4429 (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
East					15.3000	19.6403		0.6300	0.7000	0.7700		91.8355 (76)
Southwest					1.0000	36.7938		0.6300	0.7000	0.7700		11.2447 (79)
West					9.6300	19.6403		0.6300	0.7000	0.7700		57.8023 (80)
Northwest					1.0000	11.2829		0.6300	0.7000	0.7700		3.4482 (81)
West					0.4500	25.5349		0.6300	0.7000	1.0000		4.5607 (82)
Solar gains	168.8914	327.9927	536.3553	779.5411	955.0531	978.0209	930.9376	799.4998	622.6353	387.9981	210.1057	139.2247 (83)
Total gains	1039.7689	1224.8508	1392.6075	1608.9726	1741.0372	1734.2365	1656.9259	1525.1271	1371.0452	1162.7944	1032.4538	990.6677 (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	69.1699	69.3143	69.4564	70.1319	70.2597	70.8611	70.8611	70.9735	70.6282	70.2597	70.0016	69.7338
alpha	5.6113	5.6210	5.6304	5.6755	5.6840	5.7241	5.7241	5.7316	5.7085	5.6840	5.6668	5.6489
util living area												
	0.9996	0.9989	0.9964	0.9828	0.9291	0.7813	0.6042	0.6726	0.9113	0.9923	0.9990	0.9997 (86)
MIT	19.6340	19.7887	20.0440	20.4099	20.7345	20.9353	20.9878	20.9783	20.8297	20.3995	19.9558	19.6132 (87)
Th 2	20.0800	20.0818	20.0835	20.0915	20.0930	20.1000	20.1000	20.1013	20.0973	20.0930	20.0900	20.0868 (88)
util rest of house												
	0.9995	0.9985	0.9950	0.9756	0.8987	0.7009	0.4888	0.5562	0.8612	0.9882	0.9986	0.9996 (89)
MIT 2	18.4576	18.6572	18.9853	19.4549	19.8480	20.0590	20.0957	20.0926	19.9637	19.4467	18.8777	18.4359 (90)
Living area fraction												
	fLA = Living area / (4) = 0.1016 (91)											
MIT	18.5771	18.7721	19.0928	19.5519	19.9381	20.1480	20.1863	20.1826	20.0517	19.5435	18.9873	18.5555 (92)
Temperature adjustment												
adjusted MIT	18.5771	18.7721	19.0928	19.5519	19.9381	20.1480	20.1863	20.1826	20.0517	19.5435	18.9873	18.5555 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9991	0.9976	0.9928	0.9698	0.8923	0.7056	0.5003	0.5674	0.8580	0.9844	0.9978	0.9993 (94)
Useful gains	1038.8544	1221.9656	1382.6316	1560.4289	1553.5686	1223.6738	829.0086	865.3454	1176.3734	1144.6608	1030.2071	990.0116 (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												
	3415.3147	3311.5180	2999.9802	2513.1468	1940.1046	1295.5058	837.4278	881.8622	1394.3508	2106.2404	2809.8327	3406.3017 (97)
Space heating kWh												
	1768.0865	1404.1792	1203.3074	685.9569	287.5828	0.0000	0.0000	0.0000	0.0000	715.4152	1281.3304	1797.7199 (98a)
Space heating requirement - total per year (kWh/year)												9143.5782
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												
	1768.0865	1404.1792	1203.3074	685.9569	287.5828	0.0000	0.0000	0.0000	0.0000	715.4152	1281.3304	1797.7199 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9143.5782
Space heating per m2												
										(98c) / (4) =		38.3749 (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												
	1768.0865	1404.1792	1203.3074	685.9569	287.5828	0.0000	0.0000	0.0000	0.0000	715.4152	1281.3304	1797.7199 (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)												
	1915.5866	1521.3209	1303.6916	743.1819	311.5740	0.0000	0.0000	0.0000	0.0000	775.0977	1388.2236	1947.6922 (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												
	260.0610	229.8650	244.2145	215.1160	208.7117	188.2972	186.1626	193.5318	195.5951	217.7923	231.1384	257.3066 (64)

12 Appendix 2 - Be Green SAP Worksheets

Full SAP Calculation Printout



Efficiency of water heater (217)m	87.5341	87.4132	87.1419	86.4718	84.7790	79.8000	79.8000	79.8000	79.8000	86.5226	87.2954	79.8000 (216)
Fuel for water heating, kWh/month	297.0968	262.9638	280.2493	248.7702	246.1833	235.9615	233.2865	242.5210	245.1066	251.7172	264.7772	87.5635 (217)
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	293.8514 (219)
Pumps and Fa (233a)m	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	0.0000 (221)
Lighting (234a)m	47.6591	38.2339	34.4254	25.2215	19.4818	15.9168	17.7720	23.1007	30.0055	39.3688	44.4670	0.0000 (231)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-43.1511	-63.2413	-94.3975	-110.2592	-122.3481	-115.3169	-113.8016	-105.7012	-92.0515	-74.0619	-48.2539	48.9837 (232)
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 (233a)
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 (234a)
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 (235a)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-17.5399	-37.5255	-75.8124	-115.7275	-154.9252	-156.4845	-154.7484	-130.2231	-94.3319	-54.3782	-23.6351	0.0000 (235c)
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 (233b)
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 (234b)
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 (235b)
Annual totals kWh/year												0.0000 (235d)
Space heating fuel - main system 1												9906.3685 (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												3102.4848 (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)												384.6359 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2048.7701 (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												11430.7192 (238)

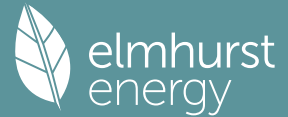
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	9906.3685	0.2100	2080.3374	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3102.4848	0.2100	651.5218	(264)
Space and water heating			2731.8592	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	384.6359	0.1443	55.5148	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1019.6077	0.1338	-136.4445	
PV Unit electricity exported	-1029.1624	0.1254	-129.0611	
Total			-265.5056	(269)
Total CO2, kg/year			2533.7977	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.6300	(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	9906.3685	1.1300	11194.1964	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3102.4848	1.1300	3505.8079	(278)
Space and water heating			14700.0043	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	384.6359	1.5338	589.9674	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1019.6077	1.4945	-1523.8396	
PV Unit electricity exported	-1029.1624	0.4603	-473.7170	
Total			-1997.5566	(283)
Total Primary energy kWh/year			13422.5159	(286)
Target Primary Energy Rate (TPER)			56.3300	(287)

Full SAP Calculation Printout



Property Reference	S10559 02 03				Issued on Date	21/12/2023
Assessment Reference	Be Green	Prop Type Ref				
Property	Mid Terrace, The Grove, The Chine					
SAP Rating	90 B	DER	1.90	TER	10.63	
Environmental	98 A	% DER < TER				82.13
CO ₂ Emissions (t/year)	0.37	DFEE	40.72	TFEE	42.08	
Compliance Check	See BREL	% DFEE < TFEE				3.23
% DPER < TPER	63.46	DPER	20.58	TPER	56.33	
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)
Basement floor	41.4500 (1a)	x	2.6500 (2a)	=	109.8425 (1a) - (3a)
Ground floor	61.9500 (1b)	x	3.0000 (2b)	=	185.8500 (1b) - (3b)
First floor	76.5400 (1c)	x	3.0000 (2c)	=	229.6200 (1c) - (3c)
Second floor	58.3300 (1d)	x	3.0500 (2d)	=	177.9065 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	238.2700				(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	703.2190 (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	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

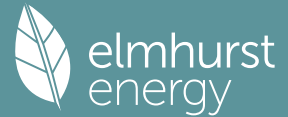
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) =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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												70.4000 (23c)
Effective ac	0.3647	0.3605	0.3562	0.3350	0.3307	0.3095	0.3095	0.3053	0.3180	0.3307	0.3392	0.3478 (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
Triple glazed windows (Uw = 1.00)			26.9300	0.9615	25.8942		(27)
Front door			2.2000	1.0000	2.2000		(26)
RL21			0.4500	1.3258	0.5966		(27a)
Heat Loss Floor 1			41.4500	0.1000	4.1450		(28)
Heat Loss Floor 2			22.4900	0.1000	2.2490		(28a)
Exposed floor			15.8000	0.1000	1.5800		(28b)
External Wall 1	157.7600	26.0800	131.6800	0.1700	22.3856		(29a)
Basement wall	23.8500		23.8500	0.1700	4.0545		(29a)
Dormer wall	5.3800	3.0500	2.3300	0.1700	0.3961		(29a)
External Roof 1	38.7800		38.7800	0.1000	3.8780		(30)
Pitched roof	58.5200	0.4500	58.0700	0.1000	5.8070		(30)
Bay window roof	1.2000		1.2000	0.1000	0.1200		(30)

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Total net area of external elements Aum(A, m2) 365.2300 (31)
Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 73.3060 (33)
Party Wall 1 172.0700 0.0000 0.0000 (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (User defined value 0.089 * total exposed area) 32.5055 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 105.8115 (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 84.6447 83.6584 82.6722 77.7409 76.7546 71.8233 71.8233 70.8370 73.7958 76.7546 78.7271 80.6997 (38)
190.4562 189.4699 188.4837 183.5524 182.5661 177.6348 177.6348 176.6485 179.6073 182.5661 184.5386 186.5111 (39)
Average = Sum(39)m / 12 = 183.3058
HLP Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
HLP (average) 0.7993 0.7952 0.7911 0.7704 0.7662 0.7455 0.7455 0.7414 0.7538 0.7662 0.7745 0.7828 (40)
Days in mont 31 28 31 30 31 30 31 31 30 31 30 31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0517 (42)
Hot water usage for mixer showers 103.6565 102.0987 99.8288 95.4856 92.2805 88.7062 86.6745 88.9273 91.3967 95.2345 99.6709 103.2593 (42a)
Hot water usage for baths 32.5419 32.0586 31.3780 30.1232 29.1835 28.1416 27.5789 28.2547 28.9905 30.1054 31.3861 32.4319 (42b)
Hot water usage for other uses 45.8823 44.2138 42.5454 40.8769 39.2085 37.5400 37.5400 39.2085 40.8769 42.5454 44.2138 45.8823 (42c)
Average daily hot water use (litres/day) 167.4504 (43)
Daily hot water use Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
182.0806 178.3712 173.7522 166.4857 160.6725 154.3878 151.7934 156.3904 161.2642 167.8852 175.2708 181.5735 (44)
Energy conte 288.3712 253.9981 267.0506 227.9106 216.2961 189.8378 183.5810 193.6440 198.8549 227.8187 249.7054 284.3002 (45)
Energy content (annual) Total = Sum(45)m = 2781.3687
Distribution loss (46)m = 0.15 x (45)m
43.2557 38.0997 40.0576 34.1866 32.4444 28.4757 27.5371 29.0466 29.8282 34.1728 37.4558 42.6450 (46)
Water storage loss:
Store volume 200.0000 (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
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
343.2722 303.5861 321.9516 281.0406 271.1971 242.9678 238.4820 248.5450 251.9849 282.7197 302.8354 339.2012 (62)
WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63a)
PV diverter -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63c)
FGHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63d)
Output from w/h 343.2722 303.5861 321.9516 281.0406 271.1971 242.9678 238.4820 248.5450 251.9849 282.7197 302.8354 339.2012 (64)
Total per year (kWh/year) = Sum(64)m = 3427.7837 (64)
12Total per year (kWh/year) 3428 (64)
Electric shower(s) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month 139.8042 124.1248 132.7151 118.2843 115.8392 105.6251 104.9615 108.3074 108.6232 119.6705 125.5311 138.4506 (65)

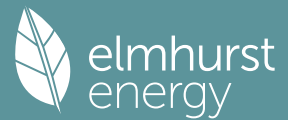
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts
(66)m Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
152.5840 152.5840 152.5840 152.5840 152.5840 152.5840 152.5840 152.5840 152.5840 152.5840 152.5840 152.5840 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
235.9462 261.2261 235.9462 243.8110 235.9462 243.8110 235.9462 235.9462 243.8110 235.9462 243.8110 235.9462 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
406.1044 410.3185 399.6991 377.0917 348.5540 321.7325 303.8141 299.6000 310.2193 332.8267 361.3645 388.1860 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
38.2584 38.2584 38.2584 38.2584 38.2584 38.2584 38.2584 38.2584 38.2584 38.2584 38.2584 38.2584 (69)
Pumps, fans 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-122.0672 -122.0672 -122.0672 -122.0672 -122.0672 -122.0672 -122.0672 -122.0672 -122.0672 -122.0672 -122.0672 -122.0672 (71)
Water heating gains (Table 5)
187.9089 184.7095 178.3806 164.2837 155.6979 146.7015 141.0772 145.5745 150.8656 160.8475 174.3487 186.0895 (72)
Total internal gains 898.7347 925.0293 882.8011 853.9617 808.9732 781.0202 749.6127 749.8958 773.6712 798.3956 848.2995 878.9969 (73)

6. Solar gains

[Jan] Area Solar flux g FF Access Gains
m2 Table 6a Specific data Specific data factor W
W/m2 or Table 6b or Table 6c Table 6d
East 15.3000 19.6403 0.5700 0.7000 0.7700 83.0893 (76)
Southwest 1.0000 36.7938 0.5700 0.7000 0.7700 10.1738 (79)
West 9.6300 19.6403 0.5700 0.7000 0.7700 52.2974 (80)
Northwest 1.0000 11.2829 0.5700 0.7000 0.7700 3.1198 (81)
West 0.4500 25.5349 0.6300 0.7000 1.0000 4.5607 (82)
Solar gains 153.2408 297.6216 486.7433 707.5110 866.8690 887.7430 844.9948 725.6496 565.0680 352.0850 190.6402 126.3206 (83)
Total gains 1051.9755 1222.6509 1369.5443 1561.4727 1675.8422 1668.7632 1594.6075 1475.5454 1338.7391 1150.4805 1038.9397 1005.3175 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	86.8784	87.3306	87.7876	90.1461	90.6331	93.1492	93.1492	93.6692	92.1261	90.6331	89.6643	88.7160	21.0000 (85)
alpha	6.7919	6.8220	6.8525	7.0097	7.0422	7.2099	7.2099	7.2446	7.1417	7.0422	6.9776	6.9144	
util living area	0.9996	0.9988	0.9956	0.9733	0.8813	0.6670	0.4887	0.5474	0.8408	0.9882	0.9989	0.9997	(86)
Living	20.1868	20.2946	20.4602	20.7015	20.8757	20.9482	20.9560	20.9553	20.9151	20.6795	20.4023	20.1854	
Non living	19.2761	19.4172	19.6320	19.9505	20.1553	20.2403	20.2451	20.2486	20.2076	19.9293	19.5704	19.2863	
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	20.5840	20.2946	20.4602	20.7015	20.8757	20.9482	20.9560	20.9553	20.9151	20.6795	20.4023	20.2994	(87)
Th 2	20.2539	20.2575	20.2611	20.2791	20.2827	20.3008	20.3008	20.3044	20.2936	20.2827	20.2755	20.2683	(88)
util rest of house	0.9995	0.9984	0.9940	0.9636	0.8443	0.6002	0.4119	0.4664	0.7829	0.9825	0.9985	0.9997	(89)
MIT 2	19.8641	19.4172	19.6320	19.9505	20.1553	20.2403	20.2451	20.2486	20.2076	19.9293	19.5704	19.4633	(90)
Living area fraction									FLA =	Living area / (4) =		0.1016	(91)
MIT	19.9373	19.5063	19.7161	20.0268	20.2285	20.3122	20.3174	20.3204	20.2795	20.0056	19.6549	19.5482	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9373	19.5063	19.7161	20.0268	20.2285	20.3122	20.3174	20.3204	20.2795	20.0056	19.6549	19.5482	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9994	0.9979	0.9925	0.9594	0.8412	0.6013	0.4137	0.4683	0.7816	0.9795	0.9979	0.9995	(94)
Useful gains	1051.3957	1220.0537	1359.2244	1498.1019	1409.7039	1003.4894	659.6625	691.0042	1046.3406	1126.9153	1036.8089	1004.8473	(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	2978.2126	2767.4616	2491.0233	2042.3564	1557.0167	1014.6874	660.3344	692.5395	1109.8888	1717.1346	2316.8719	2862.6124	(97)
Space heating kWh	1433.5518	1039.8581	842.0584	391.8633	109.6007	0.0000	0.0000	0.0000	0.0000	439.1232	921.6454	1382.1772	(98a)
Space heating requirement - total per year (kWh/year)												6559.8781	
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	1433.5518	1039.8581	842.0584	391.8633	109.6007	0.0000	0.0000	0.0000	0.0000	439.1232	921.6454	1382.1772	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6559.8781	
Space heating per m2										(98c) / (4) =		27.5313	(99)

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

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

Fraction of space heat from main system(s)

Efficiency of main space heating system 1 (in %)

Efficiency of main space heating system 2 (in %)

Efficiency of secondary/supplementary heating system, %

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1433.5518	1039.8581	842.0584	391.8633	109.6007	0.0000	0.0000	0.0000	0.0000	439.1232	921.6454	1382.1772	(98)
Space heating efficiency (main heating system 1)	381.0748	381.0748	381.0748	381.0748	381.0748	0.0000	0.0000	0.0000	0.0000	381.0748	381.0748	381.0748	(210)
Space heating fuel (main heating system)	376.1864	272.8751	220.9693	102.8311	28.7610	0.0000	0.0000	0.0000	0.0000	115.2328	241.8542	362.7050	(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	343.2722	303.5861	321.9516	281.0406	271.1971	242.9678	238.4820	248.5450	251.9849	282.7197	302.8354	339.2012	(64)
Efficiency of water heater (217)m	175.4909	175.4909	175.4909	175.4909	175.4909	175.4909	175.4909	175.4909	175.4909	175.4909	175.4909	175.4909	(216)
Fuel for water heating, kWh/month	195.6069	172.9925	183.4577	160.1454	154.5363	138.4504	135.8942	141.6284	143.5886	161.1022	172.5647	193.2870	(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	87.3652	78.9105	87.3652	84.5470	87.3652	84.5470	87.3652	87.3652	84.5470	87.3652	84.5470	87.3652	(231)
Lighting	66.4460	53.3054	47.9956	35.1637	27.1614	22.1911	24.7776	32.2068	41.8335	54.8878	61.9956	68.2927	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-48.4382	-88.6254	-167.1819	-235.0019	-287.4853	-279.2203	-273.7743	-238.3592	-180.3262	-116.3714	-58.8649	-39.2618	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-1.0825	-4.2719	-15.6635	-41.4781	-78.2055	-89.4197	-86.2027	-60.6693	-31.6418	-9.3348	-1.9607	-0.7356	(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												1721.4148	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												175.4909	
Water heating fuel used												1953.2543	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:

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(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 1.1990)	
mechanical ventilation fans (SFP = 1.1990)	1028.6547 (230a)
Total electricity for the above, kWh/year	1028.6547 (231)
Electricity for lighting (calculated in Appendix L)	536.2572 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2433.5770 (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	2806.0040 (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	1721.4148	0.1560	268.6005 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1953.2543	0.1410	275.4828 (264)
Space and water heating			544.0833 (265)
Pumps, fans and electric keep-hot	1028.6547	0.1387	142.6871 (267)
Energy for lighting	536.2572	0.1443	77.3985 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2012.9108	0.1306	-262.9138
PV Unit electricity exported	-420.6662	0.1153	-48.4961
Total			-311.4099 (269)
Total CO2, kg/year			452.7590 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.9000 (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	1721.4148	1.5777	2715.8173 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1953.2543	1.5215	2971.9035 (278)
Space and water heating			5687.7207 (279)
Pumps, fans and electric keep-hot	1028.6547	1.5128	1556.1488 (281)
Energy for lighting	536.2572	1.5338	822.5291 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2012.9108	1.4825	-2984.1454
PV Unit electricity exported	-420.6662	0.4225	-177.7242
Total			-3161.8696 (283)
Total Primary energy kWh/year			4904.5291 (286)
Dwelling Primary energy Rate (DPER)			20.5800 (287)

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

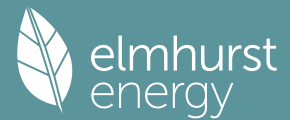
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Basement floor	41.4500 (1a)	x 2.6500 (2a)	= 109.8425 (1a) - (3a)
Ground floor	61.9500 (1b)	x 3.0000 (2b)	= 185.8500 (1b) - (3b)
First floor	76.5400 (1c)	x 3.0000 (2c)	= 229.6200 (1c) - (3c)
Second floor	58.3300 (1d)	x 3.0500 (2d)	= 177.9065 (1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	238.2700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 703.2190 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	40.0000 / (5) = 0.0569 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3069 (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) = 0.2608 (21)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
Effective ac	0.3326	0.3261	0.3195	0.2869	0.2804	0.2478	0.2478	0.2413	0.2608	0.2804	0.2935	0.3065	(22b)
	0.5553	0.5532	0.5511	0.5412	0.5393	0.5307	0.5307	0.5291	0.5340	0.5393	0.5431	0.5470	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.2000	1.0000	2.2000			(26)
TER Opening Type (Uw = 1.20)			26.9300	1.1450	30.8359			(27)
RL21			0.4500	1.4151	0.6368			(27a)
Heat Loss Floor 1			41.4500	0.1300	5.3885			(28)
Heat Loss Floor 2			22.4900	0.1300	2.9237			(28a)
Exposed floor			15.8000	0.1300	2.0540			(28b)
External Wall 1	157.7600	26.0800	131.6800	0.1800	23.7024			(29a)
Basement wall	23.8500		23.8500	0.1800	4.2930			(29a)
Dormer wall	5.3800	3.0500	2.3300	0.1800	0.4194			(29a)
External Roof 1	38.7800		38.7800	0.1100	4.2658			(30)
Pitched roof	58.5200	0.4500	58.0700	0.1100	6.3877			(30)
Bay window roof	1.2000		1.2000	0.1100	0.1320			(30)
Total net area of external elements Aum(A, m2)			365.2300					(31)
Fabric heat loss, W/K = Sum (A x U)								(32)
Party Wall 1			172.0700	0.0000	0.0000			(32)

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

250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element	18.1100	0.0500	0.9055	
E2 Other lintels (including other steel lintels)	17.1100	0.0500	0.8555	
E3 Sill	51.1200	0.0500	2.5560	
E4 Jamb	22.6100	0.1600	3.6176	
E5 Ground floor (normal)	5.4900	0.3200	1.7568	
E20 Exposed floor (normal)	12.4900	0.3200	3.9968	
E21 Exposed floor (inverted)	9.0000	0.0700	0.6300	
E22 Basement floor	38.1700	0.0000	0.0000	
E6 Intermediate floor within a dwelling	18.6000	0.0400	0.7440	
E11 Eaves (insulation at rafter level)	5.4400	0.0800	0.4352	
E13 Gable (insulation at rafter level)	22.7800	0.0800	1.8224	
E14 Flat roof	41.7200	0.0900	3.7548	
E16 Corner (normal)	18.3500	-0.0900	-1.6515	
E17 Corner (inverted - internal area greater than external area)	24.3500	0.0600	1.4610	
E18 Party wall between dwellings	19.2800	0.0800	1.5424	
P1 Party wall - Ground floor	51.7200	0.0000	0.0000	
P2 Party wall - Intermediate floor within a dwelling	12.7800	0.1200	1.5336	
P4 Party wall - Roof (insulation at ceiling level)	15.2500	0.0800	1.2200	
P5 Party wall - Roof (insulation at rafter level)	0.5500	0.0800	0.0440	
R1 Head of roof window	0.5500	0.0600	0.0330	
R2 Sill of roof window	1.6400	0.0800	0.1312	
R3 Jamb of roof window	10.7100	0.0800	0.8568	
R4 Ridge (vaulted ceiling)	21.6500	0.0400	0.8660	
R5 Ridge (inverted)				

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

27.1111 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 110.3503 (37)

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

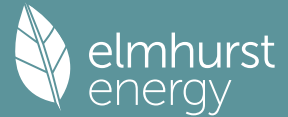
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	128.8655	128.3671	127.8786	125.5841	125.1548	123.1564	123.1564	122.7863	123.9262	125.1548	126.0233	126.9312	(38)
Heat transfer coeff	239.2157	238.7174	238.2289	235.9344	235.5051	233.5067	233.5067	233.1366	234.2764	235.5051	236.3735	237.2815	(39)
Average = Sum(39)m / 12 =												235.9323	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0040	1.0019	0.9998	0.9902	0.9884	0.9800	0.9800	0.9785	0.9832	0.9884	0.9920	0.9959	(40)
HLP (average)												0.9902	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0517 (42)
Hot water usage for mixer showers	75.3865	74.2536	72.6027	69.4441	67.1131	64.5136	63.0360	64.6744	66.4704	69.2614	72.4879	75.0977	(42a)
Hot water usage for baths	32.5419	32.0586	31.3780	30.1232	29.1835	28.1416	27.5789	28.2547	28.9905	30.1054	31.3861	32.4319	(42b)
Hot water usage for other uses	45.8823	44.2138	42.5454	40.8769	39.2085	37.5400	37.5400	39.2085	40.8769	42.5454	44.2138	45.8823	(42c)
Average daily hot water use (litres/day)												141.3865	(43)
Daily hot water use	153.8107	150.5260	146.5261	140.4442	135.5051	130.1952	128.1549	132.1375	136.3378	141.9122	148.0879	153.4118	(44)
Energy conte	243.5985	214.3471	225.2052	192.2611	182.4159	160.0902	154.9922	163.6139	168.1181	192.5735	210.9783	240.2059	(45)
Energy content (annual)										Total = Sum(45)m =		2348.4000	
Distribution loss (46)m = 0.15 x (45)m	36.5398	32.1521	33.7808	28.8392	27.3624	24.0135	23.2488	24.5421	25.2177	28.8860	31.6467	36.0309	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	294.5246	260.3448	276.1313	241.5444	233.3420	209.3735	205.9183	214.5399	217.4014	243.4996	260.2616	291.1319	(62)
WWHRS	-34.4636	-30.4799	-31.9168	-26.4283	-24.6303	-21.0763	-19.7557	-21.0082	-21.8063	-25.7073	-29.1232	-33.8254	(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)

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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	260.0610	229.8650	244.2145	215.1160	208.7117	188.2972	186.1626	193.5318	195.5951	217.7923	231.1384	257.3066 (64)
	Total per year (kWh/year) = Sum(64)m =											2627.7923 (64)
12Total per year (kWh/year)												2628 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											0.0000 (64a)
Heat gains from water heating, kWh/month	121.7374	108.0686	115.6216	103.3534	101.3941	92.6566	92.2758	95.1425	95.3259	104.7716	109.5769	120.6093 (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	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	152.5840	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	229.3724	253.9480	229.3724	237.0182	229.3724	237.0182	229.3724	229.3724	237.0182	229.3724	237.0182	229.3724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	406.1044	410.3185	399.6991	377.0917	348.5540	321.7325	303.8141	299.6000	310.2193	332.8267	361.3645	388.1860	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	38.2584	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	-122.0672	(71)
Water heating gains (Table 5)	163.6255	160.8164	155.4054	143.5464	136.2825	128.6898	124.0266	127.8797	132.3971	140.8220	152.1902	162.1093	(72)
Total internal gains	870.8776	896.8581	856.2521	829.4316	785.9840	756.2156	725.9883	725.6273	748.4098	774.7964	822.3481	851.4429	(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
East						15.3000	19.6403		0.6300	0.7000	0.7700		91.8355 (76)
Southwest						1.0000	36.7938		0.6300	0.7000	0.7700		11.2447 (79)
West						9.6300	19.6403		0.6300	0.7000	0.7700		57.8023 (80)
Northwest						1.0000	11.2829		0.6300	0.7000	0.7700		3.4482 (81)
West						0.4500	25.5349		0.6300	0.7000	1.0000		4.5607 (82)
Solar gains	168.8914	327.9927	536.3553	779.5411	955.0531	978.0209	930.9376	799.4998	622.6353	387.9981	210.1057	139.2247	(83)
Total gains	1039.7689	1224.8508	1392.6075	1608.9726	1741.0372	1734.2365	1656.9259	1525.1271	1371.0452	1162.7944	1032.4538	990.6677	(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	69.1699	69.3143	69.4564	70.1319	70.2597	70.8611	70.8611	70.9735	70.6282	70.2597	70.0016	69.7338
alpha	5.6113	5.6210	5.6304	5.6755	5.6840	5.7241	5.7241	5.7316	5.7085	5.6840	5.6668	5.6489
util living area	0.9996	0.9989	0.9964	0.9828	0.9291	0.7813	0.6042	0.6726	0.9113	0.9923	0.9990	0.9997 (86)
MIT	19.6340	19.7887	20.0440	20.4099	20.7345	20.9353	20.9878	20.9783	20.8297	20.3995	19.9558	19.6132 (87)
Th 2	20.0800	20.0818	20.0835	20.0915	20.0930	20.1000	20.1000	20.1013	20.0973	20.0930	20.0900	20.0868 (88)
util rest of house	0.9995	0.9985	0.9950	0.9756	0.8987	0.7009	0.4888	0.5562	0.8612	0.9882	0.9986	0.9996 (89)
MIT 2	18.4576	18.6572	18.9853	19.4549	19.8480	20.0590	20.0957	20.0926	19.9637	19.4467	18.8777	18.4359 (90)
Living area fraction	fLA = Living area / (4) =											0.1016 (91)
MIT	18.5771	18.7721	19.0928	19.5519	19.9381	20.1480	20.1863	20.1826	20.0517	19.5435	18.9873	18.5555 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5771	18.7721	19.0928	19.5519	19.9381	20.1480	20.1863	20.1826	20.0517	19.5435	18.9873	18.5555 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9976	0.9928	0.9698	0.8923	0.7056	0.5003	0.5674	0.8580	0.9844	0.9978	0.9993	(94)
Useful gains	1038.8544	1221.9656	1382.6316	1560.4289	1553.5686	1223.6738	829.0086	865.3454	1176.3734	1144.6608	1030.2071	990.0116	(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	3415.3147	3311.5180	2999.9802	2513.1468	1940.1046	1295.5058	837.4278	881.8622	1394.3508	2106.2404	2809.8327	3406.3017	(97)
Space heating kWh	1768.0865	1404.1792	1203.3074	685.9569	287.5828	0.0000	0.0000	0.0000	0.0000	715.4152	1281.3304	1797.7199	(98a)
Space heating requirement - total per year (kWh/year)												9143.5782	
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	1768.0865	1404.1792	1203.3074	685.9569	287.5828	0.0000	0.0000	0.0000	0.0000	715.4152	1281.3304	1797.7199	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9143.5782	
Space heating per m2											(98c) / (4) =	38.3749	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Space heating efficiency (main heating system 1)	1768.0865	1404.1792	1203.3074	685.9569	287.5828	0.0000	0.0000	0.0000	0.0000	715.4152	1281.3304	1797.7199 (98)
Space heating fuel (main heating system)	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 efficiency (main heating system 2)	1915.5866	1521.3209	1303.6916	743.1819	311.5740	0.0000	0.0000	0.0000	0.0000	775.0977	1388.2236	1947.6922 (211)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	260.0610	229.8650	244.2145	215.1160	208.7117	188.2972	186.1626	193.5318	195.5951	217.7923	231.1384	257.3066 (64)
Efficiency of water heater (217)m	87.5341	87.4132	87.1419	86.4718	84.7790	79.8000	79.8000	79.8000	79.8000	86.5226	87.2954	79.8000 (216)
Fuel for water heating, kWh/month	297.0968	262.9638	280.2493	248.7702	246.1833	235.9615	233.2865	242.5210	245.1066	251.7172	264.7772	87.5635 (217)
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	293.8514 (219)
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	0.0000 (221)
Lighting	47.6591	38.2339	34.4254	25.2215	19.4818	15.9168	17.7720	23.1007	30.0055	39.3688	44.4670	7.3041 (231)
Electricity generated by PVs (Appendix M) (negative quantity)	-43.1511	-63.2413	-94.3975	-110.2592	-122.3481	-115.3169	-113.8016	-105.7012	-92.0515	-74.0619	-48.2539	48.9837 (232)
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 (233a)
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 (234a)
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 (235a)
Electricity generated by PVs (Appendix M) (negative quantity)	-17.5399	-37.5255	-75.8124	-115.7275	-154.9252	-156.4845	-154.7484	-130.2231	-94.3319	-54.3782	-23.6351	0.0000 (235c)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Annual totals kWh/year	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)
Space heating fuel - main system 1												9906.3685 (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												3102.4848 (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)												384.6359 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2048.7701 (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												11430.7192 (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	9906.3685	0.2100	2080.3374 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3102.4848	0.2100	651.5218 (264)
Space and water heating			2731.8592 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	384.6359	0.1443	55.5148 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1019.6077	0.1338	-136.4445
PV Unit electricity exported	-1029.1624	0.1254	-129.0611
Total			-265.5056 (269)
Total CO2, kg/year			2533.7977 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.6300 (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	9906.3685	1.1300	11194.1964 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3102.4848	1.1300	3505.8079 (278)
Space and water heating			14700.0043 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	384.6359	1.5338	589.9674 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1019.6077	1.4945	-1523.8396
PV Unit electricity exported	-1029.1624	0.4603	-473.7170
Total			-1997.5566 (283)
Total Primary energy kWh/year			13422.5159 (286)
Target Primary Energy Rate (TPER)			56.3300 (287)