

Energy Statement

Jurby Avenue

Job number: S9353

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1 Executive Summary

This report has been produced by Base Energy on behalf of Irwell Valley Developments Limited and in support of the planning application for the development named as Jurby Avenue comprising the construction of one Extra-care apartment block containing 16 new apartments and communal areas falling under the requirements of Manchester Council.

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

- National Planning Policy
- The Manchester Council Core Strategy Policy EN4 Reducing CO2 Emissions by Enabling Low and Zero Carbon Development & Policy EN6 target Framework for CO2 Reduction from Low or Zero Carbon Energy Supplies

The above policies require:

- A 15 per cent reduction in CO2 over Part L 2010
- As Current Building regulations exceed the 15% CO2 reduction over Part L 2010 the development will aim to achieve current Building regulations Part L 2021

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

- Thermal specification meeting and exceeding Part L 2021 notional U-values
- A design which limits air permeability, targeting 4
- A design which limits thermal bridging
- Energy saving building services including low energy lighting, heating controls, Mechanical Ventilation with Heat
- Low carbon Air Source Heat Pumps
- Ventilation: Mechanical Ventilation with Heat Recovery to community rooms, offices, kitchenette and staff rooms

This results in a 56% reduction in CO2 emissions over Part L1 2021.

2 Existing and Proposed Development

The development site is located on land at Jurby Avenue in Manchester.

The development proposals are for the construction of one Extra-care apartment block containing 16 new apartments and communal areas.

The development proposals constitute a major 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 2023

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

Local Planning Policy

The relevant Manchester City Council Local Planning Policy EN4 and EN6 requirements are as follows.

The above policies require:

- A 15 per cent reduction in CO2 over Part L 2010
- As Current Building regulations exceed the 15% CO2 reduction over Part L 2010 the development will aim to achieve current Building regulations Part L 2021

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. A sample set of apartments have been modelled to check compliance with Part L building regulations.

Table 5.1: Baseline CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)
Baseline	11.55	288.63	3,334

The **Total Baseline CO2 Emissions** for the development are shown to be 3,334 kg/year.

6 Low Carbon Design – Fabric First – Be Lean

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

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

	Part L 2021 Limiting Parameters	Part L 2021 Notional Targets	Proposed Development
Apartment Walls	0.26	0.18	0.17
Apartment Ground Floor	0.18	0.13	0.11
Apartment Roof	0.16	0.11	0.10
Windows	1.60	1.20	1.20 G-value 0.45
Air permeability	8.00	5.00	4.00
Communal Walls	0.26	0.26	0.17
Communal Roof (flat)	0.18	0.18	0.10
Communal Floor	0.18	0.18	0.11
Communal Windows	1.60	1.60	1.20
Communal Door	1.60	1.60	1.60
Communal Air Test	8.00	8.00	7.00

- Insulation: The specified building envelope is designed to meet and 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 by targeting a global 'y-value' of 0.05

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

-
- Lighting: Low energy LED lighting throughout with a minimum efficacy of 80 lumens per watt
 - Space & Water Heating: Air Source Heat Pump
 - Heating Controls: Comprising time & temperature zone control
 - Ventilation: Mechanical Ventilation with Heat Recovery with an SFP 0.65 and efficiency 89%

Commercial energy efficient building measures

- Lighting: Low energy LED lighting throughout with a minimum efficacy of 110 lumens per watt
- Space & Water Heating: Air Source Heat Pump split AC system
- Ventilation: Mechanical Ventilation with Heat Recovery to community rooms, offices, kitchenette and staff rooms

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:

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

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

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

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

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

WIND TURBINES

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

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

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

GROUND SOURCE HEAT PUMP (GSHP)

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

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

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

AIR SOURCE HEAT PUMP (ASHP)

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

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

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

BIOMASS

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

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

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

COMBINED HEAT AND POWER (CHP)

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

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

CHP **is not recommended** for this development

DISTRICT HEATING

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

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

With reference to the Local Heat Map it has been determined that there are no existing 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 250 Watts to 420 Watts depending on the manufacture.

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

Solar PV technology **is not recommended** for this development as ASHPs are to be included and provide a greater emissions reduction

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 air Source heat pumps (ASHP) would be potentially feasible. The following low carbon technology is recommended:

ASHP

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 has been incorporated into the calculation and the results are set out below.

Table 8.1: Baseline vs Be Green CO2

	CO2 Emission Rate (kg CO2/m2/year)	Floor Area (m2)	Total Baseline Emissions (kg CO2/year)	Reduction in CO2
Baseline	11.55	288.63	3,334	N/A
Be Lean & Green Design	5.10	288.63	1,471	56%

The **CO2 Emissions reduction** as a result of energy efficient fabric and services is shown to be 1,863 kg/year.

9 Conclusion

Proposals are for the development named as Jurby Avenue comprising the construction of one Extra-care apartment block containing 16 new apartments and communal areas falling under the requirements of Manchester Council. For the purpose of this energy assessment a sample set of 6 apartments have been assessed consisting of all dwelling types over both storeys.

Under the local planning policy the proposed development is required to target:

- 15% CO2 reduction over Part L1 2010
- As current Building Regulations is in a greater improvement that 15% over Part L 2010 the development will aim to meet or exceed current Part L 2021 building regulations.

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.

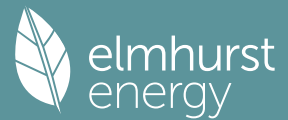
Low carbon technology will be incorporated and is to comprise air source heat pumps.

This results in a 56% CO2 reduction over Part L1 2021

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

10 **Appendix 1 Be Green DER/TER SAP Worksheets**

Full SAP Calculation Printout



Property Reference	S9353 01				Issued on Date	14/03/2024
Assessment Reference	Be Green		Prop Type Ref			
Property	Jurby Avenue, Blackley					
SAP Rating	82 B	DER	5.07	TER	11.00	
Environmental	97 A	% DER < TER				53.91
CO ₂ Emissions (t/year)	0.24	DFEE	21.25	TFEE	26.17	
Compliance Check	See BREL	% DFEE < TFEE				18.80
% DPER < TPER	5.36	DPER	54.46	TPER	57.55	
Assessor Details	Mr. Peter Kinsella				Assessor ID	L770-0002
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	48.0000	2.7000	129.6000
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	48.0000		
Dwelling volume			129.6000

2. Ventilation rate

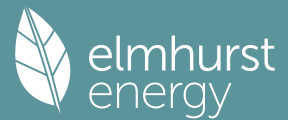
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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	3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1550 (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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821 (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) =												71.2000 (23c)
Effective ac	0.3416	0.3377	0.3339	0.3145	0.3106	0.2913	0.2913	0.2874	0.2990	0.3106	0.3184	0.3261 (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
Windows (Uw = 1.20)			6.7600	1.1450	7.7405		(27)
Heat Loss Floor 1			48.0000	0.1100	5.2800		(28a)
External wall	30.2400	6.7600	23.4800	0.1700	3.9916		(29a)
Total net area of external elements Aum(A, m ²)			78.2400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	17.0121		(33)
Heated corridors			30.9400	0.0000	0.0000		(32)
Party wall to flat			7.1300	0.0000	0.0000		(32)
Party Ceilings 1			48.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							3.9120 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	20.9241 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							

Full SAP Calculation Printout



(38)m	Jan 14.6106	Feb 14.4449	Mar 14.2792	Apr 13.4505	May 13.2848	Jun 12.4562	Jul 12.4562	Aug 12.2905	Sep 12.7876	Oct 13.2848	Nov 13.6163	Dec 13.9477 (38)
Heat transfer coeff	35.5347	35.3690	35.2032	34.3746	34.2089	33.3802	33.3802	33.2145	33.7117	34.2089	34.5403	34.8718 (39)
Average = Sum(39)m / 12 =												34.3332

HLP	Jan 0.7403	Feb 0.7369	Mar 0.7334	Apr 0.7161	May 0.7127	Jun 0.6954	Jul 0.6954	Aug 0.6920	Sep 0.7023	Oct 0.7127	Nov 0.7196	Dec 0.7265 (40)
HLP (average)												0.7153
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6314 (42)
Hot water usage for mixer showers												
91.0002	89.6326	87.6398	83.8270	81.0132	77.8753	76.0917	78.0694	80.2373	83.6065	87.5013	90.6515 (42a)	
Hot water usage for baths												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)	
Hot water usage for other uses												
31.3373	30.1978	29.0582	27.9187	26.7792	25.6396	25.6396	26.7792	27.9187	29.0582	30.1978	31.3373 (42c)	
Average daily hot water use (litres/day)												112.3876 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
122.3375	119.8304	116.6981	111.7457	107.7923	103.5149	101.7313	104.8485	108.1560	112.6647	117.6990	121.9888 (44)	
Energy conte	193.7527	170.6369	179.3606	152.9742	145.1092	127.2836	123.0352	129.8244	133.3672	152.8850	167.6838	191.0050 (45)
Energy content (annual)										Total = Sum(45)m =		1866.9179
Distribution loss (46)m = 0.15 x (45)m												
29.0629	25.5955	26.9041	22.9461	21.7664	19.0925	18.4553	19.4737	20.0051	22.9327	25.1526	28.6508 (46)	
Water storage loss:												
Store volume												150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8900 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0206 (55)
Total storage loss												
31.6386	28.5768	31.6386	30.6180	31.6386	30.6180	31.6386	31.6386	30.6180	31.6386	30.6180	31.6386 (56)	
If cylinder contains dedicated solar storage												
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 (61)	
Total heat required for water heating calculated for each month												
248.6537	220.2249	234.2616	206.1042	200.0102	180.4136	177.9362	184.7254	186.4972	207.7860	220.8138	245.9060 (62)	
WWHRS	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 (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 (63c)	
FGHRS	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												
248.6537	220.2249	234.2616	206.1042	200.0102	180.4136	177.9362	184.7254	186.4972	207.7860	220.8138	245.9060 (64)	
12Total per year (kWh/year)												2513.3329 (64)
Electric shower(s)												2513 (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												
108.3436	96.4072	103.5582	93.3679	92.1696	84.8258	84.8300	87.0874	86.8486	94.7551	98.2589	107.4300 (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	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.7614	84.9858	76.7614	79.3201	76.7614	79.3201	76.7614	76.7614	79.3201	76.7614	79.3201	76.7614 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	142.0415	143.5155	139.8012	131.8939	121.9123	112.5311	106.2638	104.7899	108.5042	116.4115	126.3930	135.7743 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571 (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)	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566 (71)
Water heating gains (Table 5)	145.6231	143.4630	139.1911	129.6777	123.8839	117.8136	114.0188	117.0530	120.6230	127.3589	136.4707	144.3951 (72)
Total internal gains	411.8972	419.4355	403.2249	388.3629	370.0288	357.1360	344.5152	346.0754	355.9185	368.0030	389.6550	404.4020 (73)

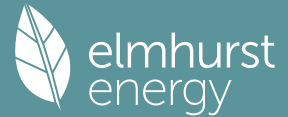
6. Solar gains

[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						
South	6.7600	46.7521	0.4500	0.0000	0.7700	109.5092 (78)						
Solar gains	109.5092	179.3479	228.4574	258.2065	269.0671	258.9405	253.0006	245.6987	238.6507	193.4435	129.8058	94.6261 (83)
Total gains	521.4064	598.7834	631.6823	646.5693	639.0959	616.0765	597.5159	591.7741	594.5693	561.4466	519.4608	499.0280 (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	
93.8051	94.2446	94.6883	96.9708	97.4406	99.8595	99.8595	100.3577	98.8777	97.4406	96.5056	95.5883	
7.2537	7.2830	7.3126	7.4647	7.4960	7.6573	7.6573	7.6905	7.5918	7.4960	7.4337	7.3726	
util living area												
0.9277	0.8561	0.7687	0.6346	0.4965	0.3467	0.2458	0.2582	0.3910	0.6259	0.8439	0.9385 (86)	
Living	20.8052	20.8376	20.8574	20.8715	20.8750	20.8781	20.8781	20.8786	20.8770	20.8728	20.8492	20.8023

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Non living	20.0687	20.1087	20.1332	20.1632	20.1695	20.1884	20.1884	20.1922	20.1810	20.1677	20.1376	20.0775
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	20.9003	20.8376	20.8574	20.8715	20.8750	20.8781	20.8781	20.8786	20.8770	20.8728	20.8492	20.8300 (87)
Th 2	20.3054	20.3084	20.3114	20.3266	20.3296	20.3449	20.3449	20.3479	20.3388	20.3296	20.3236	20.3175 (88)
util rest of house												
	0.9134	0.8341	0.7402	0.6016	0.4612	0.3112	0.2092	0.2216	0.3536	0.5880	0.8177	0.9260 (89)
MIT 2	20.2110	20.1087	20.1332	20.1632	20.1695	20.1884	20.1884	20.1922	20.1810	20.1677	20.1376	20.1207 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	20.5269	20.4428	20.4651	20.4879	20.4928	20.5045	20.5045	20.5068	20.5000	20.4909	20.4637	20.4458 (92)
Temperature adjustment												0.0000
adjusted MIT	20.5269	20.4428	20.4651	20.4879	20.4928	20.5045	20.5045	20.5068	20.5000	20.4909	20.4637	20.4458 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9182	0.8385	0.7467	0.6096	0.4698	0.3199	0.2181	0.2305	0.3628	0.5972	0.8234	0.9285 (94)
Useful gains	478.7725	502.0995	471.7086	394.1463	300.2314	197.0722	130.3331	136.4034	215.6912	335.2963	427.7026	463.3618 (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	576.6194	549.7310	491.6177	398.3282	300.7928	197.0939	130.3340	136.4048	215.7537	338.3571	461.5875	566.5199 (97)
Space heating kWh	72.7981	32.0083	14.8123	3.0109	0.4177	0.0000	0.0000	0.0000	0.0000	2.2772	24.3972	76.7496 (98a)
Space heating requirement - total per year (kWh/year)												226.4714
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	72.7981	32.0083	14.8123	3.0109	0.4177	0.0000	0.0000	0.0000	0.0000	2.2772	24.3972	76.7496 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												226.4714
Space heating per m2										(98c) / (4) =		4.7182 (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 %)												282.9807 (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	72.7981	32.0083	14.8123	3.0109	0.4177	0.0000	0.0000	0.0000	0.0000	2.2772	24.3972	76.7496 (98)
Space heating efficiency (main heating system 1)	282.9807	282.9807	282.9807	282.9807	282.9807	0.0000	0.0000	0.0000	0.0000	282.9807	282.9807	282.9807 (210)
Space heating fuel (main heating system)	25.7255	11.3111	5.2344	1.0640	0.1476	0.0000	0.0000	0.0000	0.0000	0.8047	8.6215	27.1219 (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	248.6537	220.2249	234.2616	206.1042	200.0102	180.4136	177.9362	184.7254	186.4972	207.7860	220.8138	245.9060 (64)
Efficiency of water heater	184.5000	184.5000	184.5000	184.5000	184.5000	184.5000	184.5000	184.5000	184.5000	184.5000	184.5000	184.5000 (216)
Fuel for water heating, kWh/month	134.7717	119.3631	126.9710	111.7096	108.4066	97.7852	96.4424	100.1222	101.0825	112.6211	119.6823	133.2824 (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	12.2201	11.0375	12.2201	11.8259	12.2201	11.8259	12.2201	12.2201	11.8259	12.2201	11.8259	12.2201 (231)
Lighting	15.9495	12.7953	11.5207	8.4406	6.5197	5.3267	5.9475	7.7308	10.0416	13.1751	14.8812	16.3928 (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												80.0307 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												184.5000
Water heating fuel used												1362.2401 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9100)												
mechanical ventilation fans (SFP = 0.9100)												143.8819 (230a)
Total electricity for the above, kWh/year												143.8819 (231)
Electricity for lighting (calculated in Appendix L)												128.7216 (232)

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

PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												1714.8743 (238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	80.0307	0.1600	12.8077 (261)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	1362.2401	0.1409	191.8752 (264)
Space and water heating			204.6829 (265)
Pumps, fans and electric keep-hot	143.8819	0.1387	19.9582 (267)
Energy for lighting	128.7216	0.1443	18.5785 (268)
Total CO ₂ , kg/year			243.2196 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.0700 (273)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	80.0307	1.5923	127.4318 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	1362.2401	1.5208	2071.7221 (278)
Space and water heating			2199.1539 (279)
Pumps, fans and electric keep-hot	143.8819	1.5128	217.6646 (281)
Energy for lighting	128.7216	1.5338	197.4375 (282)
Total Primary energy kWh/year			2614.2559 (286)
Dwelling Primary energy Rate (DPER)			54.4600 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	48.0000 (1b)	x 2.7000 (2b)	= 129.6000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	48.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 129.6000 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

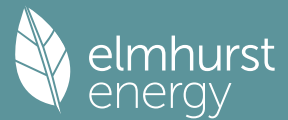
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	= 20.0000 / (5) = 0.1543 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4043 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)]	= 0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	= 0.3133 (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	0.3995	0.3917	0.3839	0.3447	0.3368	0.2977	0.2977	0.2898	0.3133	0.3368	0.3525	0.3682 (22b)
Effective ac	0.5798	0.5767	0.5737	0.5594	0.5567	0.5443	0.5443	0.5420	0.5491	0.5567	0.5621	0.5678 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opening Type (Uw = 1.20)			6.7600	1.1450	7.7405		(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400		(28a)
External wall	30.2400	6.7600	23.4800	0.1800	4.2264		(29a)
Total net area of external elements Aum(A, m ²)			78.2400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32)	= 18.2069			(33)
Heated corridors			30.9400	0.0000	0.0000		(32)
Party wall to flat			7.1300	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

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E2 Other lintels (including other steel lintels)	3.2200	0.0500	0.1610	
E3 Sill	3.2200	0.0500	0.1610	
E4 Jamb	12.6000	0.0500	0.6300	
E5 Ground floor (normal)	11.2000	0.1600	1.7920	
E18 Party wall between dwellings	10.8000	0.0600	0.6480	
E7 Party floor between dwellings (in blocks of flats)	11.2000	0.0700	0.7840	
P1 Party wall - Ground floor	18.8700	0.0800	1.5096	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	18.8700	0.0000	0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				5.6856 (36)
Point Thermal bridges				0.0000
Total fabric heat loss		(33) + (36) + (36a) =		23.8925 (37)

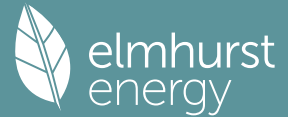
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	24.7972	24.6647	24.5348	23.9246	23.8104	23.2789	23.2789	23.1805	23.4836	23.8104	24.0414	24.2828 (38)
Average = Sum(39)m / 12 =	48.6897	48.5571	48.4272	47.8170	47.7029	47.1714	47.1714	47.0730	47.3761	47.7029	47.9338	48.1753 (39)
												47.8165
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0144	1.0116	1.0089	0.9962	0.9938	0.9827	0.9827	0.9807	0.9870	0.9938	0.9986	1.0037 (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												1.6314 (42)
Hot water usage for mixer showers												
	66.1820	65.1874	63.7381	60.9651	58.9187	56.6366	55.3394	56.7777	58.3544	60.8047	63.6373	65.9284 (42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)
Hot water usage for other uses	31.3373	30.1978	29.0582	27.9187	26.7792	25.6396	25.6396	26.7792	27.9187	29.0582	30.1978	31.3373 (42c)
Average daily hot water use (litres/day)												89.5060 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	97.5193	95.3851	92.7963	88.8838	85.6978	82.2762	80.9790	83.5569	86.2731	89.8630	93.8351	97.2657 (44)
Energy conte	154.4467	135.8272	142.6244	121.6774	115.3658	101.1682	97.9371	103.4609	106.3834	121.9432	133.6852	152.2946 (45)
Energy content (annual)										Total = Sum(45)m =		1486.8140
Distribution loss (46)m = 0.15 x (45)m												
	23.1670	20.3741	21.3937	18.2516	17.3049	15.1752	14.6906	15.5191	15.9575	18.2915	20.0528	22.8442 (46)
Water storage loss:												150.0000 (47)
Store volume												1.3938 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.7527 (55)
Enter (49) or (54) in (55)												
Total storage loss												
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage												
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
	201.0416	177.9129	189.2194	166.7693	161.9607	146.2600	144.5320	150.0558	151.4752	168.5381	178.7771	198.8895 (62)
WWHRS	-30.2556	-26.7583	-28.0198	-23.2015	-21.6229	-18.5029	-17.3435	-18.4431	-19.1438	-22.5685	-25.5673	-29.6953 (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	170.7860	151.1546	161.1996	143.5678	140.3377	127.7571	127.1885	131.6127	132.3314	145.9696	153.2098	169.1941 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		1754.3088 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												0.0000 (64a)
Heat gains from water heating, kWh/month												
	88.6294	78.8311	84.6986	76.5312	75.6350	69.7119	69.8400	71.6767	71.4459	77.8220	80.5238	87.9139 (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
	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707	81.5707 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	76.7614	84.9858	76.7614	79.3201	76.7614	79.3201	76.7614	76.7614	79.3201	76.7614	79.3201	76.7614 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	142.0415	143.5155	139.8012	131.8939	121.9123	112.5311	106.2638	104.7899	108.5042	116.4115	126.3930	135.7743 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571	31.1571 (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)												
	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566	-65.2566 (71)
Water heating gains (Table 5)												
	119.1256	117.3082	113.8421	106.2934	101.6600	96.8221	93.8710	96.3396	99.2305	104.5995	111.8386	118.1638 (72)
Total internal gains												
	388.3997	396.2807	380.8759	367.9785	350.8049	336.1444	324.3674	325.3621	334.5260	348.2436	368.0230	381.1707 (73)

6. Solar gains												
[Jan]												
	Area											
	m2											
	Solar flux											
	Table 6a											
	W/m2											
	Specific data											
	or Table 6b											
	g											
	Specific data											
	or Table 6c											
	FF											
	Access											
	factor											
	Table 6d											
	Gains											
	W											
South	6.7600							0.6300	0.7000			96.5871 (78)
Solar gains	96.5871	158.1849	201.4994	227.7381	237.3172	228.3855	223.1465	216.7062	210.4900	170.6172	114.4887	83.4602 (83)
Total gains	484.9868	554.4655	582.3753	595.7166	588.1221	564.5300	547.5139	542.0683	545.0159	518.8608	482.5117	464.6308 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	68.4608	68.6476	68.8318	69.7102	69.8770	70.6643	70.6643	70.8121	70.3590	69.8770	69.5403	69.1918	
alpha	5.5641	5.5765	5.5888	5.6473	5.6585	5.7110	5.7110	5.7208	5.6906	5.6585	5.6360	5.6128	
util living area	0.9764	0.9522	0.9154	0.8369	0.7099	0.5277	0.3782	0.3982	0.5863	0.8301	0.9493	0.9806 (86)	
MIT	20.2225	20.4185	20.6124	20.8161	20.9400	20.9908	20.9988	20.9984	20.9830	20.8497	20.5218	20.1884 (87)	
Th 2	20.0714	20.0737	20.0759	20.0865	20.0885	20.0977	20.0977	20.0995	20.0942	20.0885	20.0845	20.0803 (88)	
util rest of house	0.9700	0.9401	0.8946	0.8003	0.6537	0.4564	0.3011	0.3209	0.5149	0.7863	0.9343	0.9752 (89)	
MIT 2	19.1973	19.4400	19.6746	19.9151	20.0422	20.0928	20.0974	20.0989	20.0842	19.9567	19.5789	19.1619 (90)	
Living area fraction									fLA = Living area / (4) =				0.4583 (91)
MIT	19.6672	19.8885	20.1044	20.3280	20.4537	20.5044	20.5105	20.5112	20.4962	20.3660	20.0111	19.6324 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.6672	19.8885	20.1044	20.3280	20.4537	20.5044	20.5105	20.5112	20.4962	20.3660	20.0111	19.6324 (93)	

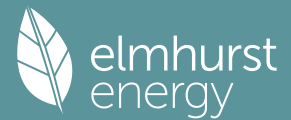
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9665	0.9373	0.8953	0.8106	0.6770	0.4889	0.3365	0.3564	0.5471	0.8005	0.9330	0.9719 (94)
Useful gains	468.7571	519.6813	521.4072	482.8847	398.1520	276.0009	184.2207	193.1824	298.1637	415.3482	450.1661	451.5935 (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	748.2222	727.7977	658.8232	546.4550	417.5773	278.5188	184.4659	193.5263	303.0256	465.8660	618.8759	743.4588 (97)
Space heating kWh	207.9221	139.8543	102.2375	45.7706	14.4524	0.0000	0.0000	0.0000	0.0000	37.5853	121.4711	217.1478 (98a)
Space heating requirement - total per year (kWh/year)												886.4409
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	207.9221	139.8543	102.2375	45.7706	14.4524	0.0000	0.0000	0.0000	0.0000	37.5853	121.4711	217.1478 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												886.4409
Space heating per m2										(98c) / (4) =		18.4675 (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	207.9221	139.8543	102.2375	45.7706	14.4524	0.0000	0.0000	0.0000	0.0000	37.5853	121.4711	217.1478 (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)	225.2677	151.5214	110.7665	49.5889	15.6581	0.0000	0.0000	0.0000	0.0000	40.7208	131.6046	235.2630 (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	170.7860	151.1546	161.1996	143.5678	140.3377	127.7571	127.1885	131.6127	132.3314	145.9696	153.2098	169.1941 (64)	
Efficiency of water heater												79.8000 (216)	
(217)m	84.5021	83.8859	83.0673	81.8043	80.5624	79.8000	79.8000	79.8000	79.8000	81.4912	83.5445	84.6205 (217)	
Fuel for water heating, kWh/month	202.1085	180.1907	194.0589	175.5016	174.1976	160.0966	159.3841	164.9282	165.8288	179.1232	183.3870	199.9447 (219)	
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)	
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (221)	
Lighting	15.9495	12.7953	11.5207	8.4406	6.5197	5.3267	5.9475	7.7308	10.0416	13.1751	14.8812	16.3928 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.9477	-32.6062	-47.2510	-53.6092	-58.2667	-54.6111	-53.9989	-50.7890	-45.1375	-37.5690	-25.3426	-19.8150 (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	-12.1930	-25.7389	-51.3024	-77.2395	-102.2776	-102.7648	-101.4944	-85.8138	-62.7806	-36.7992	-16.2819	-9.6301 (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												960.3910 (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												2138.7500 (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)												128.7216 (232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1186.2601 (233)	
Wind generation												0.0000 (234)	

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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	2127.6025 (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	960.3910	0.2100	201.6821 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2138.7500	0.2100	449.1375 (264)
Space and water heating			650.8196 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	128.7216	0.1443	18.5785 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-501.9440	0.1344	-67.4525
PV Unit electricity exported	-684.3161	0.1258	-86.1137
Total			-153.5663 (269)
Total CO2, kg/year			527.7611 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.0000 (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	960.3910	1.1300	1085.2418 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2138.7500	1.1300	2416.7875 (278)
Space and water heating			3502.0293 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	128.7216	1.5338	197.4375 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-501.9440	1.4966	-751.2312
PV Unit electricity exported	-684.3161	0.4619	-316.0958
Total			-1067.3270 (283)
Total Primary energy kWh/year			2762.2406 (286)
Target Primary Energy Rate (TPER)			57.5500 (287)