

Energy Statement

86-88 Tib Street, Manchester

Job number: 10650

Date: February 2023

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1 Executive Summary

This report has been produced by Base Energy on behalf of Concept Studio Architects and in support of the planning application for the development at 86-88 Tib Street comprising a five -storey development to provide a ground floor commercial unit and four apartments and falling under the requirements of Manchester City Council.

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

- National Planning Policy
- The Manchester City Council Local Plan Policies EN4 and EN6

The above policies require:

- That the development follows the energy hierarchy
- An energy statement to show regulated energy demand and the impact of the design proposals. There is no target as the development is classed as minor at less than 1000sqm commercial and 10 units residential

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 minimum standards
- A design which limits air permeability, targeting 4.00
- Solar Photovoltaic renewable energy generation for the residential units
- Low carbon Air Source Heat Pumps for the commercial space

This results in a 37% contribution to final energy demand from onsite low carbon and renewable technology.

2 Existing and Proposed Development

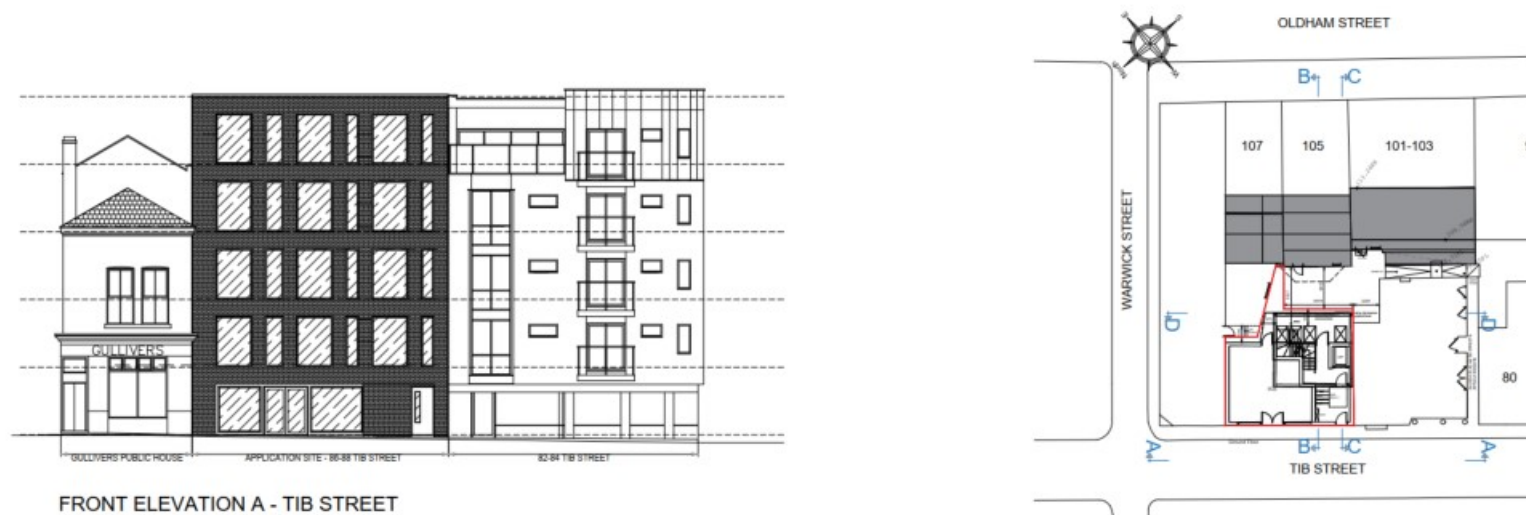
The development site is located on land at Tib Street in Manchester's Northern Quarter.

The site is brownfield, with an existing smaller building demolished.

The development proposals are for a five-storey building to provide a ground floor commercial unit with one apartment on each floor above, and constitutes a minor mixed-use 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 relevant Manchester City Council local planning policy requirements are as follows:

Development Management **Policy EN 4** of Manchester City Council's Core Strategy document sets requirements for 'Reducing CO₂ Emissions by Enabling Low and Zero Carbon Development".

"The Council will seek to reduce fuel poverty and decouple growth in the economy, growth in CO₂ emissions, and rising fossil fuel prices, through the following actions:

- All development must follow the principle of the Energy Hierarchy, being designed:
 - to reduce the need for energy through design features that provide passive heating, natural lighting and cooling
 - to reduce the need for energy through energy efficient features such as improved insulation and glazing
 - to meet residual energy requirements through the use of low or zero carbon energy generating technologies
- Wherever possible new development and retrofit projects, including energy generation plant, must be located and designed in a manner that allows advantage to be taken of opportunities for low and zero carbon energy supplies.
- Where possible new development and retrofit projects will be used as a mechanism to help improve energy efficiency and provide low and zero carbon energy supplies to existing buildings.
- Where appropriate new development and retrofit projects will be required to connect to and/or make contributions to low or zero carbon energy schemes and/or to incorporate provision to enable future connection to any existing / potential decentralised energy schemes.
- The use of building materials with low embodied carbon in new development and refurbishment schemes.

Policy EN 5 identifies “Strategic Areas for low and zero carbon decentralised energy infrastructure”. Although the proposed development lies within a strategic area the size and nature of the development and the lack of established or proposed networks in the locale make building level low carbon solutions more appropriate.

An Energy Statement is required by the Local Authority in line with **Policy EN6** of the Manchester Core Strategy Development Plan which sets out carbon dioxide reduction targets and states the following:

“Applications for residential development of 10 or more units and all other development over 1,000 sq m will be expected as a minimum to meet the target shown in Tables 12.1 or 12.2, unless this can be shown not to be viable. This should be demonstrated through an energy statement, submitted as part of the Design and Access Statement. Such a statement will be expected to set out the projected regulated energy demand and associated CO₂ emissions for all phases of the development.

The target framework relates to three broad development locations and their potential for low and zero carbon, decentralised energy. The areas are defined as follows.

- *Target 1 Network development areas: Locations where the proximity of new and existing buildings, the mix of uses and density of development provide the right conditions to support district heating (and cooling).*
- *Target 2 Electricity intense areas: Locations where the predominant building type has an all electric fit-out such as retail units and leisure complexes.*
- *Target 3 Micro-generation areas: Locations where lower densities and a fragmented mix of uses tend to mean that only building scale solutions are practical.”*

Non-domestic CO ₂ emissions reduction targets	
Table 12.2	
Target	% Minimum requirement
Target 1: Network development area	CHP/district heating anchor or connection or where not feasible, a 15% increase on Part L 2010
Target 2: Electricity intense buildings (Applies to commercial uses with a high proportion of emissions from electricity use (>45 kg CO ₂ /m ²))	+10% increase on Part L 2010
Target 3: Micro generation area	+15% increase on Part L 2010

The development is less than the 1000sqm/10 unit threshold to trigger specific targets. However, the approach as set out in this energy statement and in line with **Policies EN4 & EN6** is to follow the energy hierarchy and propose low carbon and renewable technology. The energy hierarchy will be applied as follows:

- Use less energy through an efficient building fabric
- Supply energy efficiently
- Use low carbon solutions

The Energy Statement will assess the predicted regulated energy demand for the development and propose a strategy for a contribution from energy efficiency and low carbon technology in line with the policies outlined above.

The Standard Assessment Procedure (SAP) and Simplified Building Energy Model procedure (SBEM) will be used to assess energy use. Regulated energy as calculated in SAP and SBEM includes all fixed consumption inherent in the building, i.e. fixed lighting, space heating, water- heating and ventilation.

The development will comply with the new Part L 2021 requirements on CO2 emissions, Primary Energy, and Fabric Energy Efficiency. These standards represent a significant reduction over Part L 2010 and 2013 as referenced in the Manchester Core Strategy.

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 energy demand from which any reductions or contributions have been measured.

The building has been modelled using software and compliance thresholds based on the latest Part L 2021.

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 Low Carbon Design Following the Energy Hierarchy

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

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

	Part L 2013 Limiting Parameters	Part L 2021 Limiting Parameters	Proposed Development
Walls	0.30	0.26	0.16
Ground/Exposed Floor	0.25	0.18	0.11
Roof	0.20	0.16	0.11
Windows	2.00	1.6	1.0/1.4
Doors	2.00	1.5	1.0
Air permeability	10.00	8.00	4.00

- **Insulation:** The specified building envelope is designed to better the Part L limiting values and will help to limit the energy demand of the development for space heating and cooling. The external walls will be designed to limit thermal bridging targeting a global ψ -value of 0.05
- **Air permeability:** The specified building envelope is designed to limit air leakage which would otherwise increase heating demand

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 100 luminaire lumens per circuit watt for commercial (and photoelectric dimming with a parasitic power no greater than 0.1W/m², and 80 LL/CW for residential
- **Space & Water Heating:** Split system air source heat pumps will provide low carbon space heating and cooling to the commercial units and condensing gas combi boilers for the apartments
- **Residential units** will include solar PV arrays of approx. 1.75kWp per unit, sufficient to ensure compliance with the new more stringent Part L CO₂ limits

6 Low Carbon Design Impact

The selected Low Carbon design parameters have been incorporated into the calculation model and the results are set out below.

Table 8.1: Energy Demand met by low carbon and renewable technology

	Commercial (kWh/m2/year)	Commercial Floor Area (m2)	Residential (kWh/m2/year)	Residential Floor Area (m2)	Total Energy Demand (kWh/year)	
Residual Energy Demand After fabric improvements	31.27	41.9	54.91	267.8	16,016	
	Commercial (kWh/m2/year)	Commercial Floor Area (m2)	Residential (kWh/m2/year)	Residential Floor Area (m2)	Total Energy Demand (kWh/year)	Low Carbon Energy Contribution
Low Carbon Energy	11.93+7.06 (ASHP)	41.9	19.31 (PV)	267.8	5,967	37%

Low carbon technology is shown to contribute an estimated **37% of regulated energy demand**.

7 Conclusion

Proposals are for a development at Tib Street, comprising a five-storey building to provide a ground floor commercial unit with one apartment on each floor above, and constitutes a minor mixed-use development falling under the requirements of Manchester City Council.

Under the local planning policy the proposed development is required to follow the energy hierarchy and provide an energy statement setting out energy demand and the impacts of low carbon design including the proportion of final energy demand met by low carbon technology. Due to the development size there are no specific targets. It is noted however that given the development falls under the new more stringent Part L it would automatically better the Core Strategy targets for major development by a considerable margin.

Energy modelling software has been used to calculate energy demand and low carbon energy generation.

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 and solar PV.

This results in a **37 contribution to final energy demand** from onsite low carbon technology.

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

8 Appendix 1 - SBEM Output Part L 2021

BRUKL Output Document

Compliance with England Building Regulations Part L 2021



Project name

86-88 Tib Street

As designed

Date: Fri Mar 03 10:41:51 2023

Administrative information

Building Details

Address: Manchester.

Certifier details

Name: Base Energy Services Ltd

Telephone number: 0151 933 0328

Address: 202 Stanley Road, Liverpool, L20 3EN

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.e.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v7.1.4

BRUKL compliance module version: v6.1.e.0

OSKON Compliance module version: 10.1.0.0

Foundation area [m²]: 41.9

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² annum	5.34
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	4.42
Target primary energy rate (TPER), kWh _m /m ² annum	57.5
Building primary energy rate (BPER), kWh _m /m ² annum	47.61
Do the building's emission and primary energy rates exceed the targets?	BER <= TER BPER <= TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _{a,Low}	U _{a,Calc}	U _{i,Calc}	First surface with maximum value
Walls*	0.26	0.16	0.16	Block 1 - Zone 1_W_5
Floors	0.18	0.11	0.11	Block 1 - Zone 1_S_3
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	-	-	No heat loss flat roofs
Windows** and roof windows	1.6	1.4	1.4	Block 1 - Zone 1_G_9
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	-	-	No external personnel doors
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

$U_{A-LIMIT}$ = Limiting area-weighted average U-values [W/m²K]
 U_{A-CALC} = Calculated area-weighted average U-values [W/m²]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows

^{**} Display windows and similar glazing are excluded from the U-value check. ^{***} Values for rooflights refer to the horizontal position.

^a For fire doors, limiting U-value is 1.8 W/m²/K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool

Air permeability	Limiting standard	This building
m ² /(h.m ²) at 50 Pa	8	4

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m ²]	41.9	41.9	100	Retail/Financial and Professional Services
External area [m ²]	99.3	99.3		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	MAN	MAN		Offices and Workshop Businesses
Infiltration [m ³ /m ² @ 50Pa]	4	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	31.79	44.63		Storage or Distribution
Average U-value [W/m ² K]	0.32	0.45		Hotels
Alpha value [°]	36.42	28.38		Residential institutions: Hospitals and Care Homes
				Residential institutions: Residential Schools
				Residential institutions: Universities and Colleges

^a Percentage of the building's average heat transfer coefficient which is due to thermal bridging.Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	11.93	14.81
Cooling	7.06	7.93
Auxiliary	0	0
Lighting	10.59	14.31
Hot water	1.7	1.7
Equipment*	20.26	20.26
TOTAL**	31.27	38.74

* Energy used by equipment does not count towards the total for consumption or calculating emissions

^a Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

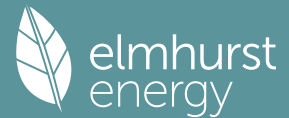
	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	250.17	266.32
Primary energy [kWh _{eq} /m ²]	47.61	57.5
Total emissions [kg/m ²]	4.42	5.34

9 Appendix 2 - SAP Output Part L 2021

Full SAP Calculation Printout



Property Reference	10650-01	Issued on Date	03/03/2023
Assessment Reference	00001	Prop Type Ref	
Property	Apartment 1, 86-88, Tib Street, Manchester		
SAP Rating	91 B	DER	13.55
Environmental	90 B	TER	13.64
CO ₂ Emissions (t/year)	0.85	% DER < TER	0.66
Compliance Check	See BREL	DFEE	35.47
% DPER < TPER	1.68	TFEE	36.20
		% DFEE < TFEE	2.02
		DPER	71.53
		TPER	72.75
Assessor Details	Mr. Peter Kinsella	Assessor ID	L770-0002
Client	S01643, null		

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	67.7900 (1b)	x 2.7000 (2b)	= 183.0330 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	67.7900		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.0330 (5)

2. Ventilation rate

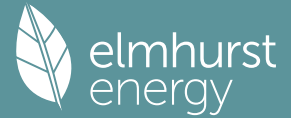
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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) = 0.1093 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3093 (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) = 0.2397 (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	0.3056	0.2996	0.2936	0.2637	0.2577	0.2277	0.2277	0.2217	0.2397	0.2577	0.2696	0.2816 (22b)
Effective ac	0.5467	0.5449	0.5431	0.5348	0.5332	0.5259	0.5259	0.5246	0.5287	0.5332	0.5364	0.5397 (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 (U _w = 0.90)			16.9800	0.8687	14.7510		(27)
Door			2.1800	1.0000	2.1800		(26)
Heatloss Floor 1			22.3500	0.1100	2.4585		(28b)
Over Commercial			42.0800	0.1100	4.6288		(28b)
External Wall 1	69.7100	19.1600	50.5500	0.1600	8.0880	150.0000	7582.5000 (29a)
Total net area of external elements A _{um} (A, m ²)			134.1400				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	32.1063	(33)
Party Wall 1			30.8900	0.0000	0.0000	70.0000	2162.3000 (32)

Full SAP Calculation Printout



Party Floor 1	64.4300	64.0000	4123.5200 (32d)
Party Ceiling 1	64.4300	90.0000	5798.7000 (32b)
Internal Wall 1	49.7900	9.0000	448.1100 (32c)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 20115.1300 (34)
 Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 296.7271 (35)
 Thermal bridges (User defined value 0.050 * total exposed area) 6.7070 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 38.8133 (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	33.0209	32.9113	32.8040	32.2998	32.2054	31.7663	31.7663	31.6849	31.9354	32.2054	32.3963	32.5958 (38)
Average = Sum(39)m / 12 =	71.8341	71.7246	71.6173	71.1130	71.0187	70.5795	70.5795	70.4982	70.7487	71.0187	71.2095	71.4091 (39)
												71.1126
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0597	1.0580	1.0565	1.0490	1.0476	1.0411	1.0411	1.0399	1.0436	1.0476	1.0504	1.0534 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

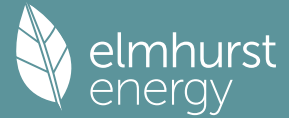
Assumed occupancy	2.1913 (42)											
Hot water usage for mixer showers	107.6371	106.0195	103.6624	99.1524	95.8242	92.1126	90.0029	92.3422	94.9065	98.8917	103.4985	107.2247 (42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)
Hot water usage for other uses	37.0711	35.7230	34.3750	33.0270	31.6789	30.3309	30.3309	31.6789	33.0270	34.3750	35.7230	37.0711 (42c)
Average daily hot water use (litres/day)												132.9388 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	144.7082	141.7425	138.0374	132.1794	127.5031	122.4435	120.3338	124.0212	127.9335	133.2667	139.2215	144.2958 (44)
Energy content (annual)	229.1823	201.8395	212.1583	180.9470	171.6437	150.5586	145.5333	153.5641	157.7548	180.8416	198.3466	225.9323 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 2208.3021
Water storage loss:	34.3774	30.2759	31.8237	27.1420	25.7466	22.5838	21.8300	23.0346	23.6632	27.1262	29.7520	33.8898 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	14.5783	13.1654	14.5715	14.0917	14.5553	14.0795	14.5448	14.5480	14.0824	14.5589	14.0986	14.5770 (61)
Total heat required for water heating calculated for each month	243.7606	215.0049	226.7298	195.0387	186.1990	164.6381	160.0782	168.1121	171.8372	195.4005	212.4452	240.5093 (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	243.7606	215.0049	226.7298	195.0387	186.1990	164.6381	160.0782	168.1121	171.8372	195.4005	212.4452	240.5093 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m = 2379.7536 (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)
Heat gains from water heating, kWh/month	79.8477	70.4030	74.1855	63.6878	60.7104	53.5806	52.0260	54.6971	55.9741	63.7696	69.4749	78.7667 (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	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	96.9305	107.3159	96.9305	100.1615	96.9305	100.1615	96.9305	96.9305	100.1615	96.9305	100.1615	96.9305 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	192.0851	194.0783	189.0554	178.3622	164.8640	152.1776	143.7023	141.7091	146.7320	157.4252	170.9234	183.6098 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565 (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)	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519 (71)
Water heating gains (Table 5)	107.3222	104.7663	99.7117	88.4553	81.5999	74.4175	69.9275	73.5176	77.7418	85.7118	96.4929	105.8693 (72)
Total internal gains	452.2072	462.0301	441.5671	422.8485	399.2640	382.6261	366.4298	368.0266	380.5047	395.9369	423.4473	442.2790 (73)

6. Solar gains

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[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		Specific data or Table 6c				Access factor Table 6d	Gains W	
Southeast				1.6300	36.7938	0.5000						0.7700	14.5467 (77)	
Northwest				15.3500	11.2829	0.5000						0.7000	42.0080 (81)	

Solar gains	56.5547	110.2869	187.9620	295.0166	387.1458	409.2878	384.2175	311.6719	224.4331	131.8835	70.2805	46.7548	(83)	
Total gains	508.7619	572.3169	629.5291	717.8651	786.4098	791.9139	750.6473	679.6985	604.9378	527.8205	493.7278	489.0338	(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	77.7839	77.9026	78.0194	78.5726	78.6770	79.1665	79.1665	79.2579	78.9772	78.6770	78.4661	78.2469		
alpha	6.1856	6.1935	6.2013	6.2382	6.2451	6.2778	6.2778	6.2839	6.2651	6.2451	6.2311	6.2165		
util living area	0.9971	0.9934	0.9818	0.9267	0.7768	0.5631	0.4128	0.4747	0.7555	0.9616	0.9934	0.9978	(86)	
MIT	20.0323	20.1804	20.4121	20.7267	20.9306	20.9918	20.9990	20.9977	20.9564	20.6765	20.3010	20.0041	(87)	
Th 2	20.0339	20.0352	20.0366	20.0427	20.0438	20.0492	20.0492	20.0502	20.0471	20.0438	20.0415	20.0391	(88)	
util rest of house	0.9960	0.9909	0.9748	0.9006	0.7171	0.4830	0.3241	0.3781	0.6721	0.9421	0.9904	0.9969	(89)	
MIT 2	19.1624	19.3104	19.5390	19.8384	20.0037	20.0462	20.0490	20.0497	20.0272	19.8009	19.4360	19.1387	(90)	
Living area fraction									fLA = Living area /		(4) =	0.3959	(91)	
MIT	19.5068	19.6549	19.8847	20.1901	20.3707	20.4206	20.4251	20.4250	20.3951	20.1476	19.7785	19.4813	(92)	
Temperature adjustment												-0.1500		
adjusted MIT	19.3568	19.5049	19.7347	20.0401	20.2207	20.2706	20.2751	20.2750	20.2451	19.9976	19.6285	19.3313	(93)	

8. Space heating requirement														

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9950	0.9891	0.9720	0.9005	0.7289	0.5019	0.3453	0.4011	0.6906	0.9409	0.9887	0.9960	(94)	
Useful gains	506.2132	566.0935	611.8896	646.4253	573.1901	397.4801	259.1732	272.6503	417.7784	496.6208	488.1251	487.0893	(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	1081.5939	1047.5274	947.8310	792.2061	605.1295	400.2284	259.3884	273.1827	434.7582	667.4030	892.1451	1080.5137	(97)	
Space heating kWh	428.0832	323.5236	249.9403	104.9621	23.7629	0.0000	0.0000	0.0000	0.0000	127.0619	290.8944	441.5078	(98a)	
Space heating requirement - total per year (kWh/year)												1989.7363		
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	428.0832	323.5236	249.9403	104.9621	23.7629	0.0000	0.0000	0.0000	0.0000	127.0619	290.8944	441.5078	(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												1989.7363		
Space heating per m2										(98c) / (4) =		29.3515	(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 %)													88.4000 (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	428.0832	323.5236	249.9403	104.9621	23.7629	0.0000	0.0000	0.0000	0.0000	127.0619	290.8944	441.5078	(98)	
Space heating efficiency (main heating system 1)	88.4000	88.4000	88.4000	88.4000	88.4000	0.0000	0.0000	0.0000	0.0000	88.4000	88.4000	88.4000	(210)	
Space heating fuel (main heating system)	484.2570	365.9770	282.7380	118.7355	26.8811	0.0000	0.0000	0.0000	0.0000	143.7352	329.0660	499.4432	(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	243.7606	215.0049	226.7298	195.0387	186.1990	164.6381	160.0782	168.1121	171.8372	195.4005	212.4452	240.5093	(64)	
Efficiency of water heater	87.7755	87.7134	87.5832	87.2873	86.8891	86.7000	86.7000	86.7000	86.7000	87.3620	87.6744	86.7000	(216)	
Fuel for water heating, kWh/month	277.7090	245.1222	258.8737	223.4445	214.2950	189.8940	184.6346	193.9010	198.1975	223.6677	242.3115	273.9505	(219)	
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)	
Lighting	21.3820	17.1535	15.4448	11.3155	8.7404	7.1410	7.9733	10.3640	13.4618	17.6626	19.9499	21.9763	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-19.1170	-31.0298	-51.5197	-64.4744	-73.4319	-69.7905	-68.5680	-62.5225	-51.7911	-38.0366	-22.1144	-15.8775	(233a)	

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

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

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

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1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	67.7900 (1b)	2.7000 (2b)	183.0330 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	67.7900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	183.0330 (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) =	0.1093 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3593	(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) =	0.2784 (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	0.3550	0.3480	0.3411	0.3063	0.2993	0.2645	0.2645	0.2576	0.2784	0.2993	0.3132	0.3272 (22b)
Effective ac	0.5630	0.5606	0.5582	0.5469	0.5448	0.5350	0.5350	0.5332	0.5388	0.5448	0.5491	0.5535 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1800	1.0000	2.1800		(26)
TER Opening Type (Uw = 1.20)			14.7700	1.1450	16.9122		(27)
Heatloss Floor 1			22.3500	0.1300	2.9055		(28b)
Over Commercial			42.0800	0.1300	5.4704		(28b)
External Wall 1	69.7100	16.9500	52.7600	0.1800	9.4968		(29a)
Total net area of external elements Aum(A, m ²)			134.1400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.9649		(33)
Party Wall 1			30.8900	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 272.0158 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element	25.8200	0.0700	1.8074
E7 Party floor between dwellings (in blocks of flats)	10.8000	0.0600	0.6480
E18 Party wall between dwellings			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			2.4554 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 39.4203 (37)

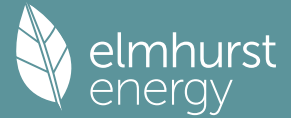
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	34.0065	33.8587	33.7139	33.0334	32.9061	32.3135	32.3135	32.2037	32.5418	32.9061	33.1637	33.4329 (38)
Average = Sum(39)m / 12 =	73.4268	73.2791	73.1342	72.4537	72.3264	71.7338	71.7338	71.6240	71.9621	72.3264	72.5840	72.8532 (39)
												72.4531

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0832	1.0810	1.0788	1.0688	1.0669	1.0582	1.0582	1.0566	1.0615	1.0669	1.0707	1.0747 (40)
HLP (average)												1.0688
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.1913 (42)
Hot water usage for mixer showers												
	78.2815	77.1051	75.3908	72.1109	69.6903	66.9910	65.4567	67.1580	69.0229	71.9212	75.2716	77.9816 (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												

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	37.0711	35.7230	34.3750	33.0270	31.6789	30.3309	30.3309	31.6789	33.0270	34.3750	35.7230	37.0711 (42c)
Average daily hot water use (litres/day)												105.8739 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.3526	112.8281	109.7658	105.1378	101.3693	97.3219	95.7876	98.8369	102.0499	106.2962	110.9947	115.0527 (44)
Energy conte	182.6903	160.6658	168.7060	143.9284	136.4625	119.6686	115.8468	122.3807	125.8377	144.2430	158.1322	180.1447 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m												
	27.4035	24.0999	25.3059	21.5893	20.4694	17.9503	17.3770	18.3571	18.8757	21.6364	23.7198	27.0217 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	47.9944	48.8123	50.3662	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	233.6492	206.6932	219.6649	193.2435	187.4214	167.6630	164.6591	172.7470	175.1528	195.2019	207.4473	231.1036 (62)
WWHRS	-35.7870	-31.6503	-33.1424	-27.4432	-25.5761	-21.8857	-20.5143	-21.8149	-22.6437	-26.6945	-30.2416	-35.1243 (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	197.8622	175.0428	186.5225	165.8003	161.8453	145.7773	144.1448	150.9320	152.5090	168.5074	177.2057	195.9793 (64)
12Total per year (kWh/year)												2022.1285 (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												
	73.4843	64.9282	68.8345	60.1850	58.1135	51.7884	50.7221	53.2831	54.1698	60.7005	64.9077	72.6378 (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	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649	109.5649 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	96.9521	107.3398	96.9521	100.1839	96.9521	100.1839	96.9521	96.9521	100.1839	96.9521	100.1839	96.9521 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	192.0851	194.0783	189.0554	178.3622	164.8640	152.1776	143.7023	141.7091	146.7320	157.4252	170.9234	183.6098 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565	33.9565 (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)	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519	-87.6519 (71)
Water heating gains (Table 5)	98.7692	96.6194	92.5194	83.5902	78.1096	71.9283	68.1749	71.6171	75.2358	81.5867	90.1496	97.6315 (72)
Total internal gains	446.6758	456.9070	437.3964	421.0058	398.7952	380.1593	364.6988	366.1478	378.0212	394.8334	420.1263	437.0629 (73)

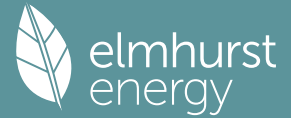
6. Solar gains

[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			
Southeast				1.4200	36.7938	0.6300	0.7000	0.7700	15.9674 (77)			
Northwest				13.3500	11.2829	0.6300	0.7000	0.7700	46.0337 (81)			
Solar gains	62.0011	120.9013	206.0368	323.3654	424.3327	448.5959	421.1201	341.6155	246.0081	144.5724	77.0476	51.2582 (83)
Total gains	508.6769	577.8083	643.4332	744.3712	823.1279	828.7552	785.8189	707.7633	624.0293	539.4058	497.1739	488.3210 (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	69.7593	69.9000	70.0385	70.6963	70.8207	71.4058	71.4058	71.5152	71.1793	70.8207	70.5694	70.3086
alpha	5.6506	5.6600	5.6692	5.7131	5.7214	5.7604	5.7604	5.7677	5.7453	5.7214	5.7046	5.6872
util living area	0.9959	0.9909	0.9760	0.9111	0.7538	0.5456	0.4004	0.4625	0.7401	0.9527	0.9910	0.9968 (86)
MIT	19.9239	20.0916	20.3528	20.7024	20.9218	20.9896	20.9985	20.9968	20.9479	20.6427	20.2264	19.8960 (87)
Th 2	20.0146	20.0164	20.0182	20.0264	20.0279	20.0351	20.0351	20.0365	20.0324	20.0279	20.0248	20.0216 (88)
util rest of house	0.9945	0.9878	0.9676	0.8828	0.6943	0.4672	0.3133	0.3673	0.6577	0.9311	0.9873	0.9956 (89)
MIT 2	18.7712	18.9857	19.3152	19.7397	19.9686	20.0299	20.0347	20.0355	20.0006	19.6822	19.1647	18.7408 (90)
Living area fraction												
MIT	19.2276	19.4236	19.7260	20.1208	20.3460	20.4099	20.4163	20.4161	20.3756	20.0625	19.5850	19.1982 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2276	19.4236	19.7260	20.1208	20.3460	20.4099	20.4163	20.4161	20.3756	20.0625	19.5850	19.1982 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9930	0.9853	0.9645	0.8858	0.7147	0.4981	0.3479	0.4051	0.6885	0.9320	0.9850	0.9943	(94)
Useful gains	505.0939	569.3388	620.5665	659.3967	588.3078	412.7759	273.3480	286.6970	429.6658	502.7330	489.7343	485.5400	(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	1096.0846	1064.2720	967.2730	812.9924	625.3332	416.7648	273.7589	287.6476	451.6083	684.3888	906.2124	1092.6657	(97)
Space heating kWh	439.6971	332.5951	257.9496	110.5889	27.5469	0.0000	0.0000	0.0000	0.0000	135.1519	299.8643	451.7015	(98a)
Space heating requirement - total per year (kWh/year)												2055.0952	
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	439.6971	332.5951	257.9496	110.5889	27.5469	0.0000	0.0000	0.0000	0.0000	135.1519	299.8643	451.7015	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2055.0952	
Space heating per m2										(98c) / (4) =		30.3156	(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 %)													92.4000 (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	439.6971	332.5951	257.9496	110.5889	27.5469	0.0000	0.0000	0.0000	0.0000	135.1519	299.8643	451.7015	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	475.8626	359.9514	279.1663	119.6849	29.8126	0.0000	0.0000	0.0000	0.0000	146.2683	324.5285	488.8544	(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	197.8622	175.0428	186.5225	165.8003	161.8453	145.7773	144.1448	150.9320	152.5090	168.5074	177.2057	195.9793	(64)
Efficiency of water heater													80.3000 (216)
(217)m	86.0403	85.7339	85.0763	83.5333	81.4460	80.3000	80.3000	80.3000	80.3000	83.9129	85.4988	86.1095	(217)
Fuel for water heating, kWh/month	229.9646	204.1699	219.2413	198.4840	198.7149	181.5409	179.5078	187.9602	189.9241	200.8121	207.2611	227.5931	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	20.1447	16.1609	14.5511	10.6607	8.2347	6.7278	7.5119	9.7643	12.6828	16.6406	18.7955	20.7046	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-15.0459	-22.5773	-34.5179	-41.3641	-46.8760	-44.5953	-44.0556	-40.4549	-34.5183	-26.9154	-17.0198	-12.8540	(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	-4.8057	-10.3828	-21.1566	-32.5545	-43.8181	-44.3090	-43.7852	-36.7142	-26.4464	-15.0964	-6.4946	-3.7800	(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													2224.1290 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													80.3000
Water heating fuel used													2425.1741 (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)													162.5795 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-670.1381 (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)

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Total delivered energy for all uses

4227.7445 (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	2224.1290	0.2100	467.0671 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2425.1741	0.2100	509.2866 (264)
Space and water heating			976.3536 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	162.5795	0.1443	23.4653 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-380.7944	0.1333	-50.7583
PV Unit electricity exported	-289.3437	0.1252	-36.2245
Total			-86.9828 (269)
Total CO2, kg/year			924.7654 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.6400 (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	2224.1290	1.1300	2513.2658 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2425.1741	1.1300	2740.4467 (278)
Space and water heating			5253.7125 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	162.5795	1.5338	249.3699 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-380.7944	1.4926	-568.3603
PV Unit electricity exported	-289.3437	0.4595	-132.9592
Total			-701.3194 (283)
Total Primary energy kWh/year			4931.8638 (286)
Target Primary Energy Rate (TPER)			72.7500 (287)