

Energy Statement for planning

541 Wilbraham Road, Chortlon

Job number: 13468

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1 Executive Summary

This report has been produced by Base Energy on behalf of Davies Partnership and in support of the planning application for the development named as 541 Wilbraham Road, Chorlton, Manchester comprising falling under the requirements of Manchester City 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 Greater Manchester Combined Local Authority, Places for everyone joint development plan, JP-S2 Carbon and Energy
- Manchester City Council Core Strategy
- The Policy CC1 - Sustainable Construction, Energy Efficiency and Retrofitting
- CC2 Renewable & Low Carbon Energy

The above policies require:

- A reduction in CO₂ over Part L 2021
- A contribution to energy and carbon savings from renewable technology

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

- Thermal specification meeting Part L 2021 notional U-values
- A design which limits air permeability, targeting 3.0
- Energy saving building services including low energy lighting and heating controls and MVHR
- Electric heating with Solar PV

This results in a 83% saving in CO₂ emissions over Part L 2021 regulations.

2 Existing and Proposed Development

The development site is located on land at 541 Wilbraham Road, Chorlton, Manchester.

The development proposals are for the construction of nine apartments over three storeys.

The development proposals constitute a minor development.



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

Figure 2.1: Site Location and proposals

3 Planning Policy

National Planning Policy Framework 2024

The NPPF was updated in December 2024 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.

Manchester City Council Core Strategy Development Plan Document:

- **Manchester Core Strategy EN4** - Reducing CO2 Emissions by Enabling Low and Zero Carbon Development
 - 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.
- **Manchester Core Strategy EN6** - Target Framework for CO2 reductions from low or zero carbon energy supplies
 - Applications for residential development of 10 or more units and all other development over 1,000m² will be expected to produce an energy statement, as part of the Design and Access Statement to show how current PART L 1 2021 will be achieved. 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 energy statement will be required to be submitted at the outset of any proposed development (outline application or before). Developers will be permitted to use green infrastructure elements such as green roofs, green walls, street trees and waterways to contribute to compliance with CO₂ mitigation, subject to the energy statement incorporating evidence such as modelling to demonstrate compliance.

The Greater Manchester Combined Authority

The relevant Planning Policy requirements are as follows.

- Places for everyone joint development plan, JP-S2 Carbon and Energy

The development should target:

- Be Net Zero Carbon where feasible
 - From adoption to regulated operational carbon emissions
 - From 2028 to all emissions in construction
- As an interim measure, development should be consistent with 2022 Part L building regulations (this would be the current Part L 2021)
- From 2025 development should also calculate and minimise carbon emissions from unregulated emissions alongside regulated emissions.

Development proposals should set out how this has been achieved in an energy statement in accordance with the energy hierarchy.

- Achieve energy demand reductions in terms of space heat demand; hot water energy demand and the delivery of on-site renewable energy generation, in accordance with Table 5.1.
- Solar PV is required where feasible to meet 40% of the ground floor area
- Include a detailed energy statement to demonstrate via site relevant evidence how the development has sought to maximize reductions in carbon emissions in line with relevant policy targets, including the minimisation of overheating risks and appropriate measures for post occupancy evaluation. Whole life cycle emissions should be considered where possible.

Based on the above the properties are aiming to go beyond Part L 2021 building regulations where feasible.

4 Methodology

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

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

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

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

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

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

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

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

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

5 Baseline Energy & CO₂

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

Table 5.1: Baseline CO₂

	CO ₂ Emission Rate (kg CO ₂ /m ² /year)	Floor Area (m ²)	Total Baseline Emissions (kg CO ₂ /year)
Baseline	12.40	585	7,254

The **Total Baseline CO₂ Emissions** for the development are shown to be 7,254 kg/year.

Table 5.2: Baseline Energy Demand

	Energy Demand (kWh/m ² /year)	Floor Area (m ²)	Total Baseline Energy Demand (kWh/year)
Baseline	65.20	585	38,142

The **Baseline Energy Demand** for the development is shown to be 38,142 kWh per year.

6 Building Form and heat loss envelope

The flats are over three storeys and have a flat roof, the below results show the heat loss factors are within the optimal range for flats with values of 2.0 or less.

Flat 1 form factor equals 2.02

Flat 2 form factor equals 1.60

Flat 3 form factor equals 1.70

Flat 4 form factor equals 1.02

Flat 5 form factor equals 0.65

Flat 6 form factor equals 0.90

Flat 7 form factor equals 1.6

Flat 8 form factor equals 2.02

Flat 9 form factor equals 1.70

7 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
Walls	0.26	0.18	0.15
Ground Floor	0.18	0.13	0.11
Roof	0.16	0.11	0.11
Windows	1.6	1.2	1.20
Doors	1.6	1.0	1.40
Air permeability	8.00	5.00	3.00

- Insulation: The specified building envelope is designed to meet the notional Part L targets and will help to limit the energy demand of the dwelling for space heating
- Thermal bridging: The design will seek to limit heat loss through thermal bridging targeting a global 'y-value' of 0.05

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

- Lighting: Low energy LED lighting throughout with a minimum efficacy of 85 lumens per watt
- Space Heating: Electric panel room heaters
- Heating Controls: Comprising programmer and appliance thermostats
- Ventilation: Mechanical ventilation with heat recovery, sfp 0.56 and 90% efficiency, flexible ductwork, sfp from commissioning certificate and approved installer

8 Low Carbon Technology Review & Recommendations

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

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

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

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

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

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

WIND TURBINES

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

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

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

GROUND SOURCE HEAT PUMP (GSHP)

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

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

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

AIR SOURCE HEAT PUMP (ASHP)

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

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

Air source heat pump technology **is recommended** for this development in the form of ASHP for hot water.

BIOMASS

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

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

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

COMBINED HEAT AND POWER (CHP)

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

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

CHP **is not recommended** for this development

DISTRICT HEATING

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

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

With reference to the Local Heat Map it has been determined that there are no existing heat networks or energy centres within a suitable radius from the development and there are no existing networks local to the site.

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 recommended** for this development however space is limited due to having a roof top amenity space.

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 and Zero Carbon Technology Summary

The low and zero carbon technology review indicates that INSERT TECH OPTIONS would be potentially feasible. The following low carbon technology is recommended:

ASHP for hot water only with an efficiency of 3.36

Solar PV at 1.6kWp per dwelling, connected to each dwelling with export meter, horizontal angle

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.

9 Low Carbon Technology – Renewable Energy Generation - Be Green

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

Table 8.1: Baseline vs Be Green CO₂

	CO ₂ Emission Rate (kg CO ₂ /m ² /year)	Floor Area (m ²)	Total Baseline Emissions (kg CO ₂ /year)	Reduction in CO ₂
Baseline	12.40	585	7,254	N/A
Be Green Design	2.20	585	1,287	-83%

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

Table 8.2: Baseline vs Be Green Energy Demand

	Energy Demand (kWh/m ² /year)	Floor Area (m ²)	Total Baseline Energy Demand (kWh/year)	Reduction in Energy Demand
Baseline	65.20	585	38,142	N/A
Be Green Design	28.15	585	16,468	-57%

The **Energy Demand reduction** as a result of energy efficient fabric and services is shown to be 000 kWh per year

Table 5.2: Fabric Energy Efficiency

	Fabric Energy Efficiency (kWh/m ² /year)
Baseline	34.10
Be Lean	30.00

10 Conclusion

Proposals are for the development named as 541 Wilbraham Road, Chorlton which consist of nine apartments over three storeys. The development falls under the requirements of The Greater Manchester Combined Local Authority.

Under the local planning policy the proposed development is required to go beyond Part L 2021 building regulations and meet various measures as set out in the Greater Manchester energy and carbon proforma.

SAP 10 and Design Builder Energy modelling software has been used to calculate a baseline against which compliance with the above can be measured.

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

Low and zero carbon technology will be incorporated and is to comprise ASHP for hot wate and Solar PV.

This results in an 83% saving in CO2 emissions over Part L 2021 regulations.

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 – SAP Worksheet Flat 1

Full SAP Calculation Printout



Property Reference	13468 1	Issued on Date	30/10/2025
Assessment Reference	v0	Prop Type Ref	Ground floor flat
Property	Flat 1, Land at 541 Wilbraham Road, Manchester		

SAP Rating	88 B	DER	2.93	TER	13.54
Environmental	98 A	% DER < TER	78.36		
CO ₂ Emissions (t/year)	0.13	DFEE	35.44	TFEE	39.00
Compliance Check	See BREL	% DFEE < TFEE	9.14		
% DPER < TPER	49.59	DPER	35.97	TPER	71.36

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)
Main dwelling	71.0000 (1b)	2.5000 (2b)	177.5000 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0000		
Dwelling volume			(3a) + (3b) + (3c) + (3d) + (3e)...(3n) = 177.5000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.1500 (18)
Number of sides sheltered	2 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (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) =												72.0000 (23c)
Effective ac	0.3026	0.2994	0.2962	0.2802	0.2771	0.2611	0.2611	0.2579	0.2675	0.2771	0.2834	0.2898 (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
Main dwelling							
Windows			11.5000	1.1450	13.1679		(27)
Corridor door			1.8900	1.4000	2.6460		(26)
Heat Loss Floor 1			71.0000	0.1100	7.8100		(28a)
External Wall 1	48.0000	11.5000	36.5000	0.1500	5.4750		(29a)
Corridor wall	25.3000	1.8900	23.4100	0.1800	4.2138		(29a)
Total net area of external elements A _{um} (A, m ²)							(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.3127		(33)
Main dwelling							
Party Wall 1			21.7000	0.0000	0.0000		(32)
Party Ceiling 1			71.0000				(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)							7.2150 (36)
Point Thermal bridges							(36a) = 0.0000
Total fabric heat loss							(33) + (36) + (36a) = 40.5277 (37)

Full SAP Calculation Printout



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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	17.7226	17.5359	17.3492	16.4156	16.2289	15.2954	15.2954	15.1087	15.6688	16.2289	16.6024	16.9758	(38)
Heat transfer coeff	58.2503	58.0636	57.8769	56.9434	56.7567	55.8231	55.8231	55.6364	56.1966	56.7567	57.1301	57.5035	(39)
Average = Sum(39)m / 12 =												56.8967	
HLP	0.8204	0.8178	0.8152	0.8020	0.7994	0.7862	0.7862	0.7836	0.7915	0.7994	0.8046	0.8099	(40)
HLP (average)												0.8014	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.2702	(42)
Hot water usage for mixer showers	85.6387	84.3517	82.4763	78.8881	76.2401	73.2871	71.6086	73.4698	75.5100	78.6806	82.3459	85.3106	(42a)	
Hot water usage for baths	26.9068	26.5072	25.9445	24.9069	24.1300	23.2685	22.8032	23.3620	23.9704	24.8922	25.9512	26.8159	(42b)	
Hot water usage for other uses	37.8787	36.5013	35.1239	33.7464	32.3690	30.9916	30.9916	32.3690	33.7464	35.1239	36.5013	37.8787	(42c)	
Average daily hot water use (litres/day)												138.3380	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Daily hot water use	150.4242	147.3602	143.5447	137.5415	132.7392	127.5472	125.4034	129.2008	133.2268	138.6967	144.7983	150.0051	(44)	
Energy content (annual)	238.2352	209.8390	220.6228	188.2874	178.6924	156.8342	151.6646	159.9776	164.2820	188.2101	206.2918	234.8718	(45)	
Distribution loss (46)m = 0.15 x (45)m	35.7353	31.4758	33.0934	28.2431	26.8039	23.5251	22.7497	23.9966	24.6423	28.2315	30.9438	35.2308	(46)	
Water storage loss:														
Store volume												201.0000	(47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)	
Temperature factor from Table 2b												0.5400	(49)	
Enter (49) or (54) in (55)												0.8694	(55)	
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)	
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(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	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	265.1866	234.1822	247.5742	214.3694	205.6438	182.9162	178.6160	186.9290	190.3640	215.1615	232.3738	261.8232	(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	265.1866	234.1822	247.5742	214.3694	205.6438	182.9162	178.6160	186.9290	190.3640	215.1615	232.3738	261.8232	(64)	
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2615.1399	(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	79.2132	69.7715	73.3571	62.6056	59.4152	52.1474	50.4285	53.1925	54.6238	62.5799	68.5920	78.0949	(65)	

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

Metabolic gains (Table 5), Watts													
(66)m	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	113.5078	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.7911	116.0188	104.7911	108.2842	104.7911	108.2842	104.7911	104.7911	108.2842	104.7911	108.2842	104.7911	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	199.6196	201.6911	196.4711	185.3585	171.3309	158.1468	149.3391	147.2676	152.4876	163.6002	177.6279	190.8119	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	(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)	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	(71)
Water heating gains (Table 5)	106.4693	103.8266	98.5982	86.9522	79.8592	72.4269	67.7802	71.4954	75.8663	84.1127	95.2667	104.9662	(72)
Total internal gains	467.9325	478.5888	456.9129	437.6472	413.0335	395.9102	378.9627	380.6065	393.6904	409.5564	438.2311	457.6216	(73)

6. Solar gains

[Jan]			Area	Solar flux	g	FF	Access	Gains				
			m2	Table 6a	Specific data	Specific data	factor	W				
				W/m2	or Table 6b	or Table 6c	Table 6d					
North			10.3600	10.6334	0.6300	0.7000	0.7700	33.6669 (74)				
West			1.1400	19.6403	0.6300	0.7000	0.7700	6.8426 (80)				
Solar gains	40.5096	77.7249	131.3723	207.7591	275.9626	293.5801	274.8372	220.5678	157.0862	92.4706	50.0645	33.6935 (83)
Total gains	508.4420	556.3136	588.2852	645.4064	688.9961	689.4904	653.8000	601.1743	550.7766	502.0270	488.2955	491.3151 (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 from living area, nil,m (see Table 9a)													
tau	84.6442	84.9164	85.1904	86.5870	86.8718	88.3246	88.3246	88.6210	87.7377	86.8718	86.3040	85.7436	
alpha	6.6429	6.6611	6.6794	6.7725	6.7915	6.8883	6.8883	6.9081	6.8492	6.7915	6.7536	6.7162	
util living area													

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	0.9935	0.9870	0.9702	0.8980	0.7325	0.5155	0.3754	0.4250	0.6839	0.9306	0.9852	0.9947 (86)
MIT	20.2489	20.3801	20.5683	20.8236	20.9627	20.9970	20.9997	20.9993	20.9821	20.8015	20.4957	20.2317 (87)
Th 2	20.2357	20.2379	20.2402	20.2516	20.2539	20.2653	20.2653	20.2676	20.2607	20.2539	20.2493	20.2448 (88)
util rest of house												
	0.9916	0.9832	0.9614	0.8720	0.6840	0.4575	0.3129	0.3577	0.6186	0.9064	0.9802	0.9932 (89)
MIT 2	19.3616	19.5294	19.7664	20.0787	20.2244	20.2636	20.2652	20.2673	20.2493	20.0617	19.6858	19.3470 (90)
Living area fraction									FLA = Living area / (4) =			0.3380 (91)
MIT	19.6615	19.8169	20.0375	20.3305	20.4740	20.5115	20.5135	20.5148	20.4970	20.3117	19.9595	19.6461 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6615	19.8169	20.0375	20.3305	20.4740	20.5115	20.5135	20.5148	20.4970	20.3117	19.9595	19.6461 (93)

8. Space heating requirement												

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9898	0.9806	0.9587	0.8750	0.6988	0.4770	0.3340	0.3805	0.6401	0.9086	0.9778	0.9915 (94)
Useful gains	503.2356	545.5236	563.9767	564.7279	481.4427	328.9212	218.3856	228.7510	352.5268	456.1185	477.4630	487.1565 (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												
Space heating kWh	894.8143	866.1313	783.5078	650.8890	497.9817	329.9992	218.4621	228.9309	359.4907	551.2058	734.6661	888.2032 (97)
Space heating requirement - total per year (kWh/year)	291.3345	215.4484	163.3312	62.0360	12.3050	0.0000	0.0000	0.0000	0.0000	70.7449	185.1863	298.3788 (98a)
Solar heating kWh												1298.7651
Solar heating contribution - total per year (kWh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Space heating kWh												0.0000
Space heating requirement after solar contribution - total per year (kWh/year)	291.3345	215.4484	163.3312	62.0360	12.3050	0.0000	0.0000	0.0000	0.0000	70.7449	185.1863	298.3788 (98c)
Space heating per m2												1298.7651 (98c) / (4) = 18.2925 (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)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												100.0000 (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	291.3345	215.4484	163.3312	62.0360	12.3050	0.0000	0.0000	0.0000	0.0000	70.7449	185.1863	298.3788 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	291.3345	215.4484	163.3312	62.0360	12.3050	0.0000	0.0000	0.0000	0.0000	70.7449	185.1863	298.3788 (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)
Space heating fuel used, main system 2												0.0000 (213)
Water heating												
Water heating requirement	265.1866	234.1822	247.5742	214.3694	205.6438	182.9162	178.6160	186.9290	190.3640	215.1615	232.3738	261.8232 (64)
Efficiency of water heater (217)m	337.3330	337.3330	337.3330	337.3330	337.3330	337.3330	337.3330	337.3330	337.3330	337.3330	337.3330	337.3330 (216)
Fuel for water heating, kWh/month	78.6127	69.4217	73.3917	63.5483	60.9617	54.2242	52.9495	55.4138	56.4321	63.7831	68.8856	77.6157 (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	11.3294	10.2330	11.3294	10.9640	11.3294	10.9640	11.3294	11.3294	10.9640	11.3294	10.9640	11.3294 (231)
Lighting	25.6460	20.5742	18.5248	13.5720	10.4834	8.5651	9.5633	12.4308	16.1464	21.1849	23.9283	26.3588 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-20.3929	-34.5799	-59.4549	-74.0193	-82.6315	-77.9082	-76.4234	-68.9178	-55.6416	-41.3968	-23.7673	-16.7980 (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	-4.3674	-11.8688	-31.9678	-64.2207	-100.2140	-106.4118	-103.5651	-80.5964	-50.3424	-21.4563	-6.6455	-3.2008 (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												1298.7651 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												337.3330
Water heating fuel used												775.2400 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6160)												
mechanical ventilation fans (SFP = 0.6160)												133.3948 (230a)
Total electricity for the above, kWh/year												133.3948 (231)
Electricity for lighting (calculated in Appendix L)												206.9781 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1216.7885 (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)

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Energy used 0.0000 (237)
Total delivered energy for all uses 1197.5895 (238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	1298.7651	0.1568	203.6645 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	775.2400	0.1412	109.4876 (264)
Space and water heating			313.1521 (265)
Pumps, fans and electric keep-hot	133.3948	0.1387	18.5035 (267)
Energy for lighting	206.9781	0.1443	29.8733 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-631.9315	0.1325	-83.7415
PV Unit electricity exported	-584.8569	0.1197	-70.0142
Total			-153.7557 (269)
Total CO ₂ , kg/year			207.7732 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.9300 (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	1298.7651	1.5806	2052.7633 (275)
Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	775.2400	1.5222	1180.0981 (278)
Space and water heating			3232.8613 (279)
Pumps, fans and electric keep-hot	133.3948	1.5128	201.7997 (281)
Energy for lighting	206.9781	1.5338	317.4700 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-631.9315	1.4897	-941.3654
PV Unit electricity exported	-584.8569	0.4391	-256.8150
Total			-1198.1804 (283)
Total Primary energy kWh/year			2553.9505 (286)
Dwelling Primary energy Rate (DPER)			35.9700 (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)
Main dwelling	71.0000	2.5000	177.5000
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0000		177.5000 (1b) - (3b)
Dwelling volume			177.5000 (4)
			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 177.5000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1690 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4190 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3562 (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	0.4541	0.4452	0.4363	0.3918	0.3829	0.3384	0.3384	0.3294	0.3562	0.3829	0.4007	0.4185 (22b)
Effective ac	0.6031	0.5991	0.5952	0.5767	0.5733	0.5572	0.5572	0.5543	0.5634	0.5733	0.5803	0.5876 (25)

3. Heat losses and heat loss parameter

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Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Main dwelling													
TER Opaque door			1.8900	1.0000	1.8900			(26)					
TER Opening Type			11.5000	1.1450	13.1679			(27)					
Heat Loss Floor 1			71.0000	0.1300	9.2300			(28a)					
External Wall 1	48.0000	11.5000	36.5000	0.1800	6.5700			(29a)					
Corridor wall	25.3000	1.8900	23.4100	0.1800	4.2138			(29a)					
Total net area of external elements Aum(A, m2)			144.3000					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	35.0717			(33)					
Main dwelling													
Party Wall 1			21.7000	0.0000	0.0000			(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)					
List of Thermal Bridges													
K1 Element				Length	Psi-value		Total						
E2 Other lintels (including other steel lintels)				6.0000	0.0500		0.3000						
E3 Sill				5.1000	0.0500		0.2550						
E4 Jamb				21.8000	0.0500		1.0900						
E5 Ground floor (normal)				22.2000	0.1600		3.5520						
E14 Flat roof				22.2000	0.0800		1.7760						
E16 Corner (normal)				5.0000	0.0900		0.4500						
E18 Party wall between dwellings				5.0000	0.0600		0.3000						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								7.7230 (36)					
Point Thermal bridges								0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	42.7947	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 35.3270	Feb 35.0924	Mar 34.8626	Apr 33.7828	May 33.5808	Jun 32.6404	Jul 32.6404	Aug 32.4663	Sep 33.0027	Oct 33.5808	Nov 33.9895	Dec 34.4167	(38)
Heat transfer coeff	78.1217	77.8872	77.6573	76.5776	76.3756	75.4352	75.4352	75.2610	75.7974	76.3756	76.7842	77.2115	(39)
Average = Sum(39)m / 12 =												76.5766	
HLP	Jan 1.1003	Feb 1.0970	Mar 1.0938	Apr 1.0786	May 1.0757	Jun 1.0625	Jul 1.0625	Aug 1.0600	Sep 1.0676	Oct 1.0757	Nov 1.0815	Dec 1.0875	(40)
HLP (average)												1.0785	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)													

Assumed occupancy													2.2702 (42)
Hot water usage for mixer showers													
62.2827	61.3467	59.9828	57.3732	55.4474	53.2997	52.0790	53.4326	54.9163	57.2223	59.8879	62.0441	62.0441	(42a)
Hot water usage for baths													
26.9068	26.5072	25.9445	24.9069	24.1300	23.2685	22.8032	23.3620	23.9704	24.8922	25.9512	26.8159	26.8159	(42b)
Hot water usage for other uses													
37.8787	36.5013	35.1239	33.7464	32.3690	30.9916	30.9916	32.3690	33.7464	35.1239	36.5013	37.8787	37.8787	(42c)
Average daily hot water use (litres/day)												116.8046	(43)
Daily hot water use	Jan 127.0682	Feb 124.3552	Mar 121.0511	Apr 116.0266	May 111.9464	Jun 107.5599	Jul 105.8738	Aug 109.1636	Sep 112.6332	Oct 117.2384	Nov 122.3404	Dec 126.7386	(44)
Energy conte	201.2450	177.0801	186.0511	158.8346	150.7014	132.2574	128.0452	135.1673	138.8880	159.0914	174.2963	198.4420	(45)
Energy content (annual)										Total = Sum(45)m =		1940.0997	
Distribution loss (46)m = 0.15 x (45)m													
30.1867	26.5620	27.9077	23.8252	22.6052	19.8386	19.2068	20.2751	20.8332	23.8637	26.1444	29.7663	29.7663	(46)
Water storage loss:													
Store volume													150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.3938 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.7527 (55)
Total storage loss													
23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	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	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													
247.8399	219.1659	232.6460	203.9264	197.2963	177.3492	174.6401	181.7622	183.9799	205.6863	219.3881	245.0369	245.0369	(62)
WWHRS	-28.4730	-25.1818	-26.3689	-21.8345	-20.3490	-17.4128	-16.3217	-17.3565	-18.0159	-21.2388	-24.0610	-27.9458	(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	219.3668	193.9841	206.2771	182.0919	176.9473	159.9365	158.3184	164.4057	165.9639	184.4475	195.3272	217.0911	(64)
12Total per year (kWh/year)									Total per year (kWh/year) = Sum(64)m =			2224.1574	(64)
Electric shower(s)												2224	(64)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	104.1899	92.5477	99.1379	88.8860	87.3841	80.0491	79.8509	82.2191	82.2537	90.1738	94.0270	103.2579	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan 113.5078	Feb 113.5078	Mar 113.5078	Apr 113.5078	May 113.5078	Jun 113.5078	Jul 113.5078	Aug 113.5078	Sep 113.5078	Oct 113.5078	Nov 113.5078	Dec 113.5078	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
104.7911	116.0188	104.7911	108.2842	104.7911	108.2842	104.7911	104.7911	108.2842	104.7911	108.2842	104.7911	104.7911	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
199.6196	201.6911	196.4711	185.3585	171.3309	158.1468	149.3391	147.2676	152.4876	163.6002	177.6279	190.8119	190.8119	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	34.3508	(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)													
-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	-90.8062	(71)
Water heating gains (Table 5)													
140.0401	137.7198	133.2499	123.4527	117.4518	111.1792	107.3265	110.5095	114.2413	121.2013	130.5930	138.7875	138.7875	(72)
Total internal gains	504.5033	515.4820	494.5645	477.1478	453.6261	434.6626	418.5091	419.6206	432.0654	449.6450	476.5574	494.4429	(73)

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W	
North				10.3600	10.6334	0.6300	0.7000	0.7700			33.6669 (74)	
West				1.1400	19.6403	0.6300	0.7000	0.7700			6.8426 (80)	
Solar gains	40.5096	77.7249	131.3723	207.7591	275.9626	293.5801	274.8372	220.5678	157.0862	92.4706	50.0645	33.6935 (83)
Total gains	545.0128	593.2069	625.9368	684.9069	729.5887	728.2427	693.3463	640.1884	589.1515	542.1156	526.6219	528.1363 (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	63.1138	63.3038	63.4912	64.3864	64.5567	65.3615	65.3615	65.5127	65.0491	64.5567	64.2131	63.8578
alpha	5.2076	5.2203	5.2327	5.2924	5.3038	5.3574	5.3574	5.3675	5.3366	5.3038	5.2809	5.2572
util living area	0.9938	0.9893	0.9789	0.9381	0.8299	0.6363	0.4738	0.5314	0.7881	0.9540	0.9877	0.9947 (86)
MIT	19.8375	19.9830	20.2170	20.5654	20.8396	20.9702	20.9948	20.9908	20.9100	20.5758	20.1635	19.8213 (87)
Th 2	20.0006	20.0033	20.0059	20.0184	20.0207	20.0316	20.0316	20.0336	20.0274	20.0207	20.0160	20.0111 (88)
util rest of house	0.9918	0.9859	0.9718	0.9171	0.7781	0.5510	0.3722	0.4246	0.7106	0.9340	0.9831	0.9930 (89)
MIT 2	18.6594	18.8461	19.1436	19.5801	19.8876	20.0150	20.0300	20.0304	19.9672	19.6020	19.0860	18.6465 (90)
Living area fraction									fLA = Living area / (4) =			0.3380 (91)
MIT	19.0576	19.2304	19.5064	19.9132	20.2094	20.3379	20.3561	20.3550	20.2859	19.9312	19.4502	19.0436 (92)
Temperature adjustment												0.0000
adjusted MIT	19.0576	19.2304	19.5064	19.9132	20.2094	20.3379	20.3561	20.3550	20.2859	19.9312	19.4502	19.0436 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9892	0.9824	0.9672	0.9145	0.7890	0.5789	0.4067	0.4608	0.7330	0.9317	0.9796	0.9907 (94)
Useful gains	539.1494	582.7480	605.4341	626.3164	575.6533	421.6137	281.9517	295.0288	431.8686	505.1103	515.8701	523.2499 (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	1152.8903	1116.1553	1010.0440	843.3607	649.9077	432.8376	283.3434	297.6607	468.8757	712.6764	948.3033	1146.0951 (97)
Space heating kWh	456.6233	358.4497	301.0297	156.2719	55.2453	0.0000	0.0000	0.0000	0.0000	154.4292	311.3519	463.3968 (98a)
Space heating requirement - total per year (kWh/year)												2256.7978
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	456.6233	358.4497	301.0297	156.2719	55.2453	0.0000	0.0000	0.0000	0.0000	154.4292	311.3519	463.3968 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2256.7978
Space heating per m2										(98c) / (4) =		31.7859 (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	456.6233	358.4497	301.0297	156.2719	55.2453	0.0000	0.0000	0.0000	0.0000	154.4292	311.3519	463.3968 (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)	494.7164	388.3529	326.1427	169.3087	59.8540	0.0000	0.0000	0.0000	0.0000	167.3122	337.3260	502.0551 (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	219.3668	193.9841	206.2771	182.0919	176.9473	159.9365	158.3184	164.4057	165.9639	184.4475	195.3272	217.0911 (64)
Efficiency of water heater (217)m	85.6647	85.4172	84.9063	83.7188	81.7719	79.8000	79.8000	79.8000	79.8000	83.6642	85.1000	79.8000 (216)
Fuel for water heating, kWh/month	256.0759	227.1018	242.9467	217.5043	216.3914	200.4216	198.3940	206.0222	207.9748	220.4617	229.5266	253.2681 (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	21.7735	17.4675	15.7276	11.5227	8.9005	7.2718	8.1193	10.5538	13.7083	17.9860	20.3152	22.3787 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-24.1465	-35.1353	-52.1077	-60.5126	-66.9201	-63.0743	-62.3085	-58.0055	-50.6825	-41.0416	-26.9349	-20.7508 (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	-10.5062	-22.3994	-45.0769	-68.5188	-91.3944	-92.1159	-91.0252	-76.7000	-55.7367	-32.2937	-14.1116	-8.2853 (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)												

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(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												2445.0680	(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												2676.0891	(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)												175.7249	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1169.7843	(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												4213.0976	(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	2445.0680	0.2100	513.4643 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2676.0891	0.2100	561.9787 (264)
Space and water heating			1075.4430 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	175.7249	0.1443	25.3625 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-561.6203	0.1339	-75.2130
PV Unit electricity exported	-608.1640	0.1255	-76.3531
Total			-151.5661 (269)
Total CO2, kg/year			961.1686 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.5400 (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	2445.0680	1.1300	2762.9268 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2676.0891	1.1300	3023.9806 (278)
Space and water heating			5786.9075 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	175.7249	1.5338	269.5326 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-561.6203	1.4949	-839.5738
PV Unit electricity exported	-608.1640	0.4608	-280.2586
Total			-1119.8323 (283)
Total Primary energy kWh/year			5066.7086 (286)
Target Primary Energy Rate (TPER)			71.3600 (287)