

Energy Statement for Planning

Client: D2 Architects

Site: The Roby Public House,
Greystone Road,
Knowsley,
L14 6UH

Proposals: The construction of nine two and three-storey dwellings

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Report Details:

Prepared by	Date	Project	Revision
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1 Introduction

This Energy Statement report has been prepared in support of the planning application for the construction of nine two and three-storey dwellings at The Roby Public House, Greystone Road, Knowsley, L14 6UH.

National Planning Policy Framework 2023

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

Knowsley Council Local Plan Core Strategy (Policy CS22: Sustainable and Low Carbon Development) states:

New developments will be required to meet high standards of sustainable design and construction and reduce carbon emissions. This should be achieved by Designing new buildings for flexible uses throughout their lifetime, Making the most effective and sustainable use of water, aggregates and other resources and Limiting energy use by incorporating high standards of insulation, heat retention, natural ventilation and passive solar techniques which has been applied to this project.

Government targets for carbon reduction in new development are expected to be implemented through updates to the Building Regulations.

Based on the above, there is not a specific percentage target the proposed dwellings will need to achieve. As such, this report demonstrates how the dwellings will meet current Building Regulation requirements for energy efficiency (baseline scenario) and, through an assessment of energy efficiency measures through a fabric first approach, how the dwellings could potentially achieve a greater saving in CO2 emissions

This report has been prepared in line with Part L Building Regulations 2021.

2 Existing and Proposed Development



The site is located at The Roby Public House, Greystone Road, Knowsley, L14 6UH (Figure 1).

As previously detailed, proposals are for the construction of nine two and three-storey dwellings, consisting of three terrace house types at The Roby Public House, Greystone Road, Knowsley, L14 6UH.

The front entrance of the dwellings all face in a North-East direction.

Given the scale and nature of the site, there are some constraints to the development proposals in terms of the layout, positioning and orientation of the proposed dwellings. Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).

3 SAP and Building Regulations

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

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

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

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

- Part L1 Domestic Assessments
- Part L2 Non-Domestic Assessments

Part L1 2021 sets out the minimum energy efficiency requirements for **domestic assessments** and is based on the SAP methodology.

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

4 Baseline Scenario (Part L 2021 Compliance)

SAP modelling has been used to calculate the Building Regulations compliance threshold for the whole building. The Target Emission Rate forms the baseline from which any CO₂ emissions reductions can be measured. Simply complying with the minimum standards for building fabric and services would not usually be sufficient to ensure a 'pass' as the limiting values are designed to allow a degree of flexibility in achieving the main CO₂ limiting criterion. The SAP 10 software has been used to assess the dwelling and calculate a TER rate for the baseline dwelling.

For the purpose of the report, all ten dwellings have been assessed.

Table 1: Baseline SAP 10 Calculation Results

	Target Emission Rate (TER) (kg CO₂/m²/year)	Total Floor Area (for all dwellings) (m²)	Total Baseline Emissions (kg CO₂/year)
Greystone Road	11.3	872.2	9,855

The total Baseline CO₂ emissions for the development is projected to be in total 9,855 kg/year.

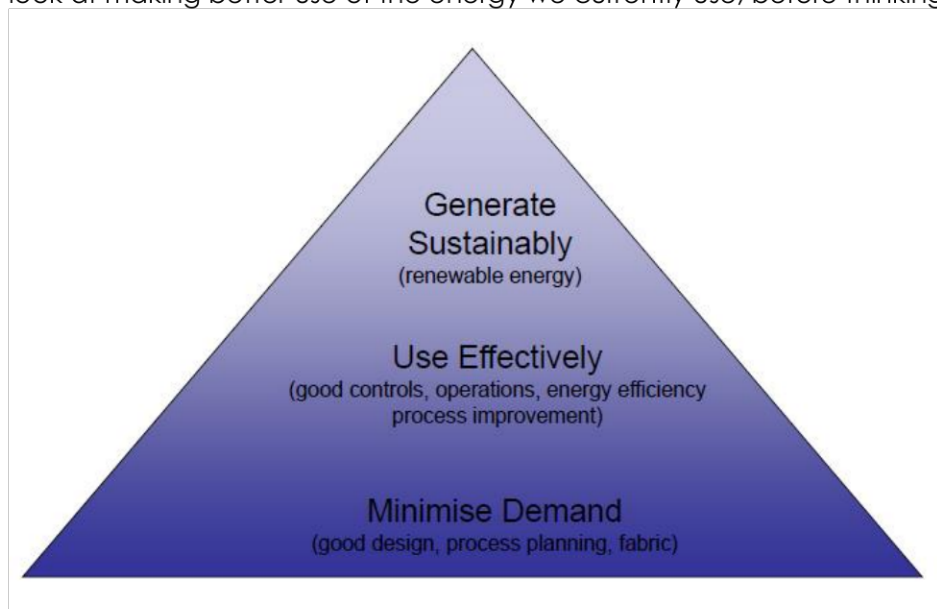
5 Fabric Energy Efficiency Improvements

Be Lean Proposed Strategy

- Minimise demand
- Energy Efficient controls
- Generate energy

The Energy Hierarchy

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



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

Table 4: Fabric Standards (u-values W/m²K)

	Part L Notional Dwelling	Proposed Dwelling
Walls	0.18	0.17
Ground Floor	0.13	0.09
Roof at ceiling	0.11	0.11
Roof pitched	0.11	0.13
Windows	1.2	1.2
Doors	1.0	1.1
Air test	5	4
Ventilation	Natural	Natural
Thermal Bridging	0.05	y-value 0.05
Heating	89.5% Gas combi	89% Gas combi
Heating controls	Time and temp zone control	Time and temp zone, delayed start thermostat
Lights	85lm/w	85lm/w
Shower heat recovery	36%	Yes
Shower	NA	From combi boiler

- Insulation - good levels of insulation with u-values exceeding Part L1 2021 requirements (see Table 1)
- Thermal Bridging Details will have to be provided such as Non-Government approved details or PSI values will need to be independently calculated. These will provide continuity of insulation and therefore apply a significant improvement factor on the energy performance of a dwelling. Currently the y-value has been assumed and thermal bridging psi values will need to be assessed at building regulations design stage.

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- Ventilation - design air permeability (DAP) of 4 m³/hm² (@50Pa) (noting that a DAP of 8 m³/hm² (@50Pa) or lower is the Part L1 minimum standard)
 - Heating and Controls – Mains gas, 89% efficient mains gas combi boiler with time and temperature zone control and a delayed start thermostat
 - Lighting - the design of the dwelling allows for natural daylight which will reduce the energy use from internal lighting. All internal lighting will be low energy with each light fitting have 85 lumens / watt or more

5 Renewable Technology Review

As previously detailed, in order to meet the requirements of the Knowsley Council Local Plan Core Strategy Policy CS22, the development will aim to achieve a reduction in CO2 emissions against Building Regulations Part L (2021) through the provision of on-site renewable technologies or low-carbon technology were feasible.

The baseline TER calculation indicates that the total CO2 emissions are 11,368 kg/year and as such, a saving in CO2 emissions will be provided through the provision of energy efficiency measures and low carbon or renewable technologies if feasible.

RENEWABLE TECHNOLOGIES

The Carbon Trust defines renewable energy as '*energy that occurs naturally and repeatedly in the environment. Therefore, it does not release any net greenhouse gases into the atmosphere*'.

There are a range of renewable technologies - some which generate electricity (such as photovoltaic (PV) panels, wind turbines), some which generate heat (such as ground source heat pumps, solar thermal panels for water heating), and some which generate both electricity and heat (Micro Combined Heat and Power). All can afford different benefits in reducing CO2 emissions from a dwelling. However, their feasibility depends on a number of factors including:

- Orientation
- Space (inside and outside of the dwelling)
- Surrounding topography
- Wind speed (for wind turbines)

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
- Micro 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 suitable wind resource, and subsequently both a structural survey and planning permission.

The topography of the site is relatively flat, and the proposed dwelling is to be situated in close proximity to other existing dwellings which are either side of the new dwelling. Wind turbines also cause noise issues to the neighbouring properties and are known to be visually unsightly.

As such, wind turbines are not considered to be a suitable or feasible renewable technology for this particular 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 in order to transfer the heat from this water into a higher temperature water circuit used for heating purposes. The loop can be fitted horizontally (laid in a shallow trench) or vertically (in a borehole).

It is important to note that GSHPs require electricity to drive the pump and is therefore not considered a completely 'renewable' technology.

For a GSHP to be installed, there needs to be suitable outdoor space for digging a trench or borehole (and the associated digging machinery) to support the ground loop.

Based on the proposed site layout plan, there would limited space for the installation of a horizontal GSHP system. There is also limited space for a plant room which would be required for a GSHP system. The need for an in depth design analysis to assess geology and thermal dynamics would be costly and not guarantee feasibility. Scheme success is also highly dependent on expertise and design. System efficiencies degrade over the heating season.

Other technologies are available and provide more immediate, straight forward benefits and therefore such a system is currently deemed unsuitable for consideration in 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 a compressor where its temperature is increased. There are two main types of ASHP systems:

- Air to Water - distributes heat through the wet central heating
- Air to Air - produces warm air which is circulated by fans

Like GSHPs, ASHPs require electricity to drive the pump and therefore is not a completely 'renewable' system.

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.

An air source heat pump both external and inside does require a significant amount of space and this would need to be designed into the development with a possible reworking of the scheme design. An air source heat pump does make some noise when operating, as both a fan and a compressor will be in motion, however new technologies are being developed to overcome this noise issue.

Plans indicate that there is enough space for an ASHP at the rear or side of the development. Further research with an ASHP supplier should be carried out to check on the feasibility of the system. There is also the potential for an ASHP for hot water only which could be reviewed further.

As such ASHPs are considered feasible for this development subject to further design work of the scheme.

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.

The biomass boiler system would require a substantial amount of space for large boiler plant plus storage of the wood chip fuel. The transport and delivery of fuel would also have to be considered in terms of impacts to site layout and impact on surroundings. Air quality is also a concern with biomass and the proximity of boiler flues between properties would be an issue and could result in very high outlets. Even with design to mitigate immediate local impact, damaging particulates would be released and cause 'downstream impacts'. There are supply chain drawbacks in terms of security of supply, transport CO2 emissions quality and provenance.

Therefore, biomass is deemed unsuitable 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.

The viability of CHP is dependent upon the building base load requirements for both heat and power. Buildings with high heat demands and constant power demands lend themselves to CHP. It is important that the unit is not oversized as this will lead to inefficient operation. Excess generated electricity can be exported to the grid when circumstances allow. The heat generated during this process is supplied to an appropriately matched heat demand that would otherwise be met by a conventional boiler. CHP systems are highly efficient, making use of the heat which would otherwise be wasted when generating electrical or mechanical power. This allows heat requirements to be met that would otherwise require additional fuel to be burnt.

Given there will not be a constant hot water demand at the development, it would not be justified to operate the CHP all year all round at this development. The commercial viability of this type of system therefore would not be suitable for this particular 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.

There are no known existing or proposed heat networks / energy centres within a moderate radius from the development and there are no existing networks local to the site.

SOLAR PHOTOVOLTAIC (PV)

Solar PV cells (which are mounted together in panels or tiles on the roof) convert sunlight into electricity. The cells are made from layers of semi-conducting material; when the light shines on the cell, an electric field is created across the layers. Although PV cells are most effective in bright sunlight, they can still generate electricity on a cloudy day. The power of a PV cell is measured in kilowatts peak (kWp). Each PV panel produces 0.25Watts to 0.35Watts depending on the manufacture.

In general, PV cells should be installed so that they are orientated in a southerly direction (to face between south-east and south-west), in an un-shaded area. The site plan shows there is space for PV on the rear and front pitched roofs, however there are roof lights and dormers on the roofs which could limit the total number of panels. The amount of PV panels which could be installed should be check with a solar PV installer.

Based on the proposed layout of the dwellings, and that there is no significant over-shading, PV is considered a feasible solution in providing the saving in CO2 emissions from the dwellings. However, this should be checked with a PV installer.

SOLAR HOT WATER

Solar hot water systems absorb energy from the sun and transfer this energy using heat exchangers to heat water. Systems should be roof mounted and oriented to face between a south-east and south-west direction.

There are three main types of solar heating (as defined by the Carbon Trust):

- Flat Plate Collectors - a sheet of black metal that absorbs the sun's energy encases the collector system. Water is fed through the system in pipes which conduct the heat to the water
- Evacuated Tubes - a series of parallel glass heat tubes grouped together, with each tube containing an absorber tube. Sunlight passes through the outer glass tube to heat the absorber tube which in doing so, the heat is transferred to water flowing through the tube
- Solar Matting - a range of extruded hollow sections of flexible black material that can be used for solar collection. Water passes through the hollow tubes absorbing the heat from the sun

Based on the proposed layout of the dwellings, and that there is no significant over-shading, Solar Thermal would also be a feasible solution in providing the saving in CO2 emissions from the dwellings.

6 Renewable Technology Scenario – Be Green

In order to demonstrate how the development can achieve a reduction in CO₂ emissions against Building Regulations Part L1 2021 through the incorporation of renewable/low carbon technology, the baseline TER SAP calculation (as detailed in Section 4 of this report) has been re-run with Solar PV.

The development has a pitched roof with space to mount PV panels, however this should be checked with an installer. A PV system totalling 18kWp has been incorporated into the SAP calculations (2.0kWp for each plot) facing in an East and Westerly direction with none or little shading with an export capable meter. Please note that panels tend to range from 0.25kWp to 0.45kWp. We would recommend contacting a PV Supplier to check if such a PV system is feasible. If there is not sufficient roof space for the PV system suggested, then we will have to explore other solutions such as heat pump technologies.

Table 3: Be Green Results with Solar PV

	SAP 10 - Be Green Calculation
Target Emission Rate (TER) (kg CO₂/m²/year)	11.30
Dwelling Emission Rate (DER) (kg CO₂/m²/year)	10.93
CO₂ Reduction	-3.26%
Total TER Baseline CO₂ Emissions (kg/year)	9,855
Total DER CO₂ Emissions (kg/year)	9,534

As required by the local council a reduction in CO₂ emissions is to be provided through energy efficient measures and renewable or low carbon technologies.

Based on the Be Green calculations, a saving in CO₂ emissions over Part L 2021 can feasibly be achieved by improving the fabric elements and fitting a total 18kWp Solar PV system (for the whole development) with an export capable meter present per plot. Therefore, the development can achieve a reduction in CO₂ over Building Regulations Part L1 2021. This also equates to a 3% reduction in CO₂ emissions over the current Part L 2021. This equates to a 34% saving in CO₂ emissions over the previous Part L.

Please note if any changes are made to the above energy specifications, then this will result in a different result and could be less than the original calculations.

7 Conclusion

There are proposals for the construction of ten three-storey dwellings at The Roby Public House, Greystone Road, Knowsley, L14 6UH.

Under the Knowsley Council Local Plan Core Strategy Policy CS22, the proposed dwellings will be required to meet high standards of sustainable design and construction and reduce carbon emissions. However, there is no specific target from the council, therefore best efforts will be made to improve the energy efficiency of the dwellings were feasible over the new Part L 2021 building regulations.

Given the scale and nature of the site in particular the surrounding buildings, this constrains the development proposals in terms of the layout, positioning and orientation of the proposed dwellings. Subsequently, these constraints will impact on the feasibility of certain renewable technologies.

A review of the renewable and low carbon technologies indicates that PV is the most feasible and desirable renewable technology by the client to meet the Core Strategy requirements, and this has been used for the basis of the assessment. This would be combined with a high standard of energy efficient measures below.

The following Be Green section has been used in the Energy Statement

- An estimated PV System totalling 18kWp for the whole development

This would be combined with the following energy efficient building fabric and services below

- Low fabric u-values
- High air tightness
- Low energy lighting
- Shower heat recovery

The SAP 10 software has been used to calculate a baseline scenario (to meet Building Regulation requirements Part L1 2021) along with a Be Green scenario which shows how the development can feasibly achieve a 3.0 % reduction in CO2 emissions through the provision of energy efficient building fabric services and renewable technology. This also equates to a 34 % reduction in CO2 emissions over the previous Part L 2013.

The development has been assessed using the latest SAP 10 software and this results in a reduction in CO2 emissions over Part L 2021 and therefore helps contribute to Policy CS22 of the Knowsley Council Local Plan Core Strategy; *the proposed dwellings will be required to meet high standards of sustainable design and construction and reduce carbon emissions.*

Appendices

Appendix A: DER Worksheet – Be Green with Renewable/Low Carbon Technology

Full SAP Calculation Printout



Property Reference	10304 Plot 1 Block A				Issued on Date	28/05/2024
Assessment Reference	v0		Prop Type Ref	Two storey dormer		
Property	Plot 1 Two storey Block A, Knowsley					
SAP Rating	92 A	DER	11.81	TER	12.17	
Environmental	90 B	% DER < TER				2.96
CO ₂ Emissions (t/year)	0.8	DFEE	37.69	TFEE	38.54	
Compliance Check	See BREL	% DFEE < TFEE				2.20
% DPER < TPER	2.04	DPER	62.36	TPER	63.66	
Assessor Details	Mr. Peter Kinsella				Assessor ID	L770-0002
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	40.5000 (1b)	x 2.4000 (2b)	= 97.2000 (1b) - (3b)
First floor	40.5000 (1c)	x 2.2000 (2c)	= 89.1000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 186.3000 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1610 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.3610 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3340 (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	0.4258	0.4174	0.4091	0.3673	0.3590	0.3173	0.3173	0.3089	0.3340	0.3590	0.3757	0.3924 (22b)
Effective ac	0.5906	0.5871	0.5837	0.5675	0.5644	0.5503	0.5503	0.5477	0.5558	0.5644	0.5706	0.5770 (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
Front door			3.7800	1.1000	4.1580		(26)
Windows (Uw = 1.20)			12.4200	1.1450	14.2214		(27)
Heat Loss Floor 1			40.5000	0.1100	4.4550		(28a)
External Wall 1	87.0000	10.9200	76.0800	0.1800	13.6944		(29a)
Dormer wall	26.4000	5.2800	21.1200	0.1800	3.8016		(29a)
Roof pitched	19.0000		19.0000	0.1300	2.4700		(30)
Roof ceiling	13.0000		13.0000	0.1100	1.4300		(30)
Roof dormers	12.8000		12.8000	0.1300	1.6640		(30)
Total net area of external elements Aum(A, m ²)			198.7000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8944		(33)
Party Wall 1			14.2000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							9.9350 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	55.8294 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Full SAP Calculation Printout



(38)m	36.3125	36.0961	35.8840	34.8876	34.7012	33.8335	33.8335	33.6728	34.1677	34.7012	35.0783	35.4726 (38)
Heat transfer coeff	92.1419	91.9255	91.7133	90.7170	90.5306	89.6628	89.6628	89.5021	89.9971	90.5306	90.9077	91.3020 (39)
Average = Sum(39)m / 12 =												90.7161
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1376	1.1349	1.1323	1.1200	1.1177	1.1069	1.1069	1.1050	1.1111	1.1177	1.1223	1.1272 (40)
HLP (average)												1.1200
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												

Assumed occupancy												2.4816 (42)
Hot water usage for mixer showers												
90.5126	89.1524	87.1702	83.3778	80.5791	77.4580	75.6840	77.6511	79.8074	83.1585	87.0324	90.1658 (42a)	
Hot water usage for baths												
28.4311	28.0089	27.4143	26.3179	25.4970	24.5867	24.0950	24.6855	25.3284	26.3024	27.4213	28.3350 (42b)	
Hot water usage for other uses												
40.0437	38.5875	37.1314	35.6753	34.2191	32.7630	32.7630	34.2191	35.6753	37.1314	38.5875	40.0437 (42c)	
Average daily hot water use (litres/day)												146.2130 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	158.9874	155.7488	151.7159	145.3710	140.2952	134.8077	132.5420	136.5557	140.8110	146.5923	153.0413	158.5445 (44)
Energy conte	251.7972	221.7842	233.1817	199.0057	188.8644	165.7618	160.2981	169.0845	173.6341	198.9244	218.0353	248.2423 (45)
Energy content (annual)										Total = Sum(45)m =		2428.6136
Distribution loss (46)m = 0.15 x (45)m												
37.7696	33.2676	34.9773	29.8508	28.3297	24.8643	24.0447	25.3627	26.0451	29.8387	32.7053	37.2364 (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	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	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	16.9592	15.3129	16.9424	16.3719	16.9025	16.3420	16.8768	16.8847	16.3491	16.9116	16.3890	16.9560 (61)
Total heat required for water heating calculated for each month												
268.7563	237.0971	250.1242	215.3776	205.7669	182.1038	177.1749	185.9692	189.9832	215.8360	234.4244	265.1983 (62)	
WWHRS	-57.2509	-50.6332	-53.0201	-43.9028	-40.9158	-35.0120	-32.8181	-34.8988	-36.2247	-42.7049	-48.3795	-56.1907 (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												
211.5054	186.4639	197.1040	171.4748	164.8511	147.0919	144.3568	151.0704	153.7585	173.1311	186.0449	209.0076 (64)	
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2095.8602 (64)
Electric shower(s)												2096 (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												
87.9624	77.5715	81.7685	70.2624	67.0230	59.2013	57.5183	60.4418	61.8206	70.3703	76.5940	86.7796 (65)	

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

Metabolic gains (Table 5), Watts												
(66)m	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
117.5715	130.1684	117.5715	121.4905	117.5715	121.4905	117.5715	117.5715	121.4905	117.5715	121.4905	117.5715 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
221.5178	223.8165	218.0239	205.6923	190.1258	175.4954	165.7215	163.4228	169.2154	181.5470	197.1135	211.7439 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078 (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)												
-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624 (71)
Water heating gains (Table 5)												
118.2290	115.4337	109.9039	97.5866	90.0847	82.2240	77.3096	81.2389	85.8620	94.5837	106.3806	116.6392 (72)	
Total internal gains												
520.5417	532.6421	508.7228	487.9928	461.0054	439.4334	420.8260	422.4567	436.7913	456.9256	488.2081	509.1780 (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	
Northeast			1.6800		11.2829		0.5000		0.0000		0.7700	7.2978 (75)
East			2.6400		19.6403		0.5000		0.0000		0.7700	19.9624 (76)
West			8.1000		19.6403		0.5000		0.0000		0.7700	61.2482 (80)

Solar gains	88.5083	173.7199	288.3919	425.5228	526.7096	541.6878	514.6657	438.4503	336.8964	206.6606	110.4425	72.7433 (83)
Total gains	609.0500	706.3620	797.1146	913.5156	987.7150	981.1212	935.4916	860.9069	773.6877	663.5862	598.6506	581.9213 (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	61.0472	61.1909	61.3324	62.0060	62.1337	62.7350	62.7350	62.8477	62.5020	62.1337	61.8759	61.6088
alpha	5.0698	5.0794	5.0888	5.1337	5.1422	5.1823	5.1823	5.1898	5.1668	5.1422	5.1251	5.1073
util living area												
0.9945	0.9877	0.9690	0.9033	0.7639	0.5692	0.4189	0.4727	0.7341	0.9447	0.9884	0.9956 (86)	
MIT	19.7623	19.9618	20.2599	20.6374	20.8836	20.9795	20.9965	20.9937	20.9293	20.5812	20.1063	19.7315 (87)
Th 2	19.9703	19.9724	19.9746	19.9846	19.9864	19.9952	19.9952	19.9968	19.9918	19.9864	19.9826	19.9787 (88)
util rest of house												
0.9927	0.9837	0.9590	0.8743	0.7051	0.4866	0.3248	0.3725	0.6514	0.9214	0.9841	0.9942 (89)	

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MIT 2	18.5418	18.7963	19.1716	19.6314	19.8946	19.9843	19.9941	19.9947	19.9469	19.5793	18.9892	18.5086 (90)
Living area fraction									fLA = Living area / (4) =			0.2160 (91)
MIT	18.8055	19.0481	19.4067	19.8487	20.1082	20.1993	20.2107	20.2105	20.1592	19.7957	19.2306	18.7728 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6555	18.8981	19.2567	19.6987	19.9582	20.0493	20.0607	20.0605	20.0092	19.6457	19.0806	18.6228 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9893	0.9780	0.9499	0.8647	0.7033	0.4912	0.3310	0.3790	0.6530	0.9113	0.9785	0.9913 (94)	
Useful gains	602.5487	690.8139	757.2141	789.9588	694.6493	481.8935	309.6132	326.2726	505.2076	604.7382	585.7699	576.8726 (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	1322.7397	1286.7821	1169.9594	979.6295	747.6243	488.5997	310.2948	327.6244	531.8082	818.9139	1089.1273	1316.8282 (97)	
Space heating kWh	535.8222	400.4906	307.0825	136.5629	39.4134	0.0000	0.0000	0.0000	0.0000	159.3467	362.4174	550.5269 (98a)	
Space heating requirement - total per year (kWh/year)												2491.6627	
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	535.8222	400.4906	307.0825	136.5629	39.4134	0.0000	0.0000	0.0000	0.0000	159.3467	362.4174	550.5269 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												2491.6627	
Space heating per m2										(98c) / (4) =		30.7613 (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	535.8222	400.4906	307.0825	136.5629	39.4134	0.0000	0.0000	0.0000	0.0000	159.3467	362.4174	550.5269 (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)	606.1337	453.0437	347.3784	154.4829	44.5853	0.0000	0.0000	0.0000	0.0000	180.2565	409.9744	622.7680 (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	211.5054	186.4639	197.1040	171.4748	164.8511	147.0919	144.3568	151.0704	153.7585	173.1311	186.0449	209.0076 (64)	
Efficiency of water heater	87.9121	87.8528	87.7275	87.4455	87.0229	86.7000	86.7000	86.7000	86.7000	87.5065	87.8159	86.7000 (216)	
Fuel for water heating, kWh/month	240.5873	212.2459	224.6775	196.0933	189.4341	169.6561	166.5015	174.2450	177.3454	197.8493	211.8578	237.7097 (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	28.4740	22.8429	20.5675	15.0686	11.6394	9.5095	10.6179	13.8015	17.9268	23.5209	26.5668	29.2653 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)	-22.8631	-36.2366	-58.9008	-72.8855	-82.7160	-78.5291	-77.1927	-70.5631	-58.9025	-44.0047	-26.2362	-19.1441 (233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)	
Electricity generated by PVs (Appendix M) (negative quantity)	-8.8102	-21.6006	-51.7424	-91.2062	-132.4057	-137.7277	-134.2195	-106.1294	-68.2047	-33.3384	-12.3423	-6.6653 (233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)	
Annual totals kWh/year													
Space heating fuel - main system 1													2818.6229 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													86.7000
Water heating fuel used													2398.2027 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
central heating pump													41.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													86.0000 (231)
Electricity for lighting (calculated in Appendix L)													229.8012 (232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV generation													-1452.5668 (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													4080.0601 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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Space heating - main system 1	2818.6229	0.2100	591.9108 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2398.2027	0.2100	503.6226 (264)
Space and water heating			1095.5334 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	229.8012	0.1443	33.1674 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-648.1744	0.1327	-86.0254
PV Unit electricity exported	-804.3924	0.1221	-98.2402
Total			-184.2656 (269)
Total CO2, kg/year			956.3645 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.8100 (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	2818.6229	1.1300	3185.0439 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2398.2027	1.1300	2709.9691 (278)
Space and water heating			5895.0130 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	229.8012	1.5338	352.4768 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-648.1744	1.4904	-966.0453
PV Unit electricity exported	-804.3924	0.4481	-360.4610
Total			-1326.5063 (283)
Total Primary energy kWh/year			5051.0843 (286)
Dwelling Primary energy Rate (DPER)			62.3600 (287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	40.5000 (1b)	x 2.4000 (2b)	= 97.2000 (1b) - (3b)
First floor	40.5000 (1c)	x 2.2000 (2c)	= 89.1000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 186.3000 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	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) = 0.1610 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4110 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3802 (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	0.4848	0.4753	0.4657	0.4182	0.4087	0.3612	0.3612	0.3517	0.3802	0.4087	0.4277	0.4467 (22b)
Effective ac	0.6175	0.6129	0.6085	0.5875	0.5835	0.5652	0.5652	0.5618	0.5723	0.5835	0.5915	0.5998 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			3.7800	1.0000	3.7800		(26)
TER Opening Type (Uw = 1.20)			12.4200	1.1450	14.2214		(27)
Heat Loss Floor 1			40.5000	0.1300	5.2650		(28a)
External Wall 1	87.0000	10.9200	76.0800	0.1800	13.6944		(29a)
Dormer wall	26.4000	5.2800	21.1200	0.1800	3.8016		(29a)
Roof pitched	19.0000		19.0000	0.1100	2.0900		(30)
Roof ceiling	13.0000		13.0000	0.1100	1.4300		(30)
Roof dormers	12.8000		12.8000	0.1100	1.4080		(30)

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Total net area of external elements Aum(A, m2)						198.7000						(31)			
Fabric heat loss, W/K = Sum (A x U)						(26)...(30) + (32) =						45.6904		(33)	
Party Wall 1						14.2000		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)						10.4000		0.0500		0.5200					
E3 Sill						8.6000		0.0500		0.4300					
E4 Jamb						24.2000		0.0500		1.2100					
E5 Ground floor (normal)						27.0000		0.1600		4.3200					
E6 Intermediate floor within a dwelling						18.0000		0.0000		0.0000					
E16 Corner (normal)						9.2000		0.0900		0.8280					
E18 Party wall between dwellings						9.2000		0.0600		0.5520					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												7.8600		(36)	
Point Thermal bridges												(36a) =		0.0000	
Total fabric heat loss												(33) + (36) + (36a) =		53.5504 (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		37.9630	37.6825	37.4076	36.1162	35.8746	34.7498	34.7498	34.5415	35.1830	35.8746	36.3633	36.8744	(38)	
Average = Sum(39)m / 12 =		91.5134	91.2329	90.9580	89.6666	89.4249	88.3002	88.3002	88.0919	88.7334	89.4249	89.9137	90.4247	(39)	
		89.6654													
HLP		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
HLP (average)		1.1298	1.1263	1.1229	1.1070	1.1040	1.0901	1.0901	1.0876	1.0955	1.1040	1.1100	1.1164	(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														2.4816 (42)	
Hot water usage for mixer showers															
65.8273 64.8381 63.3965 60.6384 58.6030 56.3331 55.0429 56.4735 58.0417 60.4789 63.2963 65.5751														(42a)	
Hot water usage for baths															
28.4311 28.0089 27.4143 26.3179 25.4970 24.5867 24.0950 24.6855 25.3284 26.3024 27.4213 28.3350														(42b)	
Hot water usage for other uses															
40.0437 38.5875 37.1314 35.6753 34.2191 32.7630 32.7630 34.2191 35.6753 37.1314 38.5875 40.0437														(42c)	
Average daily hot water use (litres/day)														123.4541 (43)	
Daily hot water use		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Energy conte		134.3021	131.4345	127.9422	122.6316	118.3191	113.6828	111.9009	115.3781	119.0454	123.9127	129.3052	133.9538	(44)	
Energy content (annual)		212.7018	187.1610	196.6424	167.8766	159.2803	139.7863	135.3345	142.8622	146.7949	168.1484	184.2189	209.7393	(45)	
Distribution loss (46)m = 0.15 x (45)m		31.9053	28.0741	29.4964	25.1815	23.8920	20.9679	20.3002	21.4293	22.0192	25.2223	27.6328	31.4609	(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	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)	
Total heat required for water heating calculated for each month		263.6607	233.1884	247.6013	217.1916	210.2392	189.1014	186.2934	193.8211	196.1099	219.1073	233.5340	260.6982	(62)	
WWHRS		-30.0935	-26.6149	-27.8696	-23.0772	-21.5071	-18.4038	-17.2506	-18.3443	-19.0412	-22.4475	-25.4303	-29.5362	(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		233.5672	206.5734	219.7317	194.1145	188.7321	170.6976	169.0428	175.4768	177.0687	196.6598	208.1036	231.1620	(64)	
		Total per year (kWh/year) = Sum(64)m =												2370.9301 (64)	
12Total per year (kWh/year)														2371 (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		83.4631	73.7379	78.1233	68.1477	65.7004	58.8077	57.7384	60.2414	61.1381	68.6491	73.5816	82.4780	(65)	
5. Internal gains (see Table 5 and 5a)															
Metabolic gains (Table 5), Watts															
(66)m		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5		124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	124.0781	(66)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5		117.5715	130.1684	117.5715	121.4905	117.5715	121.4905	117.5715	117.5715	121.4905	117.5715	121.4905	117.5715	(67)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5		221.5178	223.8165	218.0239	205.6923	190.1258	175.4954	165.7215	163.4228	169.2154	181.5470	197.1135	211.7439	(68)	
Pumps, fans		35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	35.4078	(69)	
Losses e.g. evaporation (negative values) (Table 5)		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)	
Water heating gains (Table 5)		-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	-99.2624	(71)	
Total internal gains		112.1815	109.7290	105.0045	94.6496	88.3070	81.6774	77.6054	80.9696	84.9140	92.2703	102.1966	110.8576	(72)	
		514.4943	526.9373	503.8233	485.0558	459.2277	438.8868	421.1218	422.1874	435.8433	454.6122	484.0241	503.3964	(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							
Northeast	1.6800	11.2829		0.6300		0.7000		0.7700		5.7930				(75)	
East	2.6400	19.6403		0.6300		0.7000		0.7700		15.8461				(76)	
West	8.1000	19.6403		0.6300		0.7000		0.7700		48.6188				(80)	

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Solar gains	70.2579	137.8989	228.9255	337.7800	418.1021	429.9918	408.5416	348.0418	267.4283	164.0472	87.6693	57.7437 (83)
Total gains	584.7522	664.8362	732.7488	822.8358	877.3298	868.8785	829.6634	770.2292	703.2717	618.6594	571.6934	561.1400 (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	61.4664	61.6554	61.8418	62.7324	62.9019	63.7032	63.7032	63.8538	63.3921	62.9019	62.5600	62.2064
alpha	5.0978	5.1104	5.1228	5.1822	5.1935	5.2469	5.2469	5.2569	5.2261	5.1935	5.1707	5.1471
util living area	0.9954	0.9904	0.9775	0.9296	0.8153	0.6249	0.4636	0.5174	0.7761	0.9562	0.9904	0.9962 (86)
MIT	19.7431	19.9229	20.1985	20.5731	20.8447	20.9703	20.9948	20.9911	20.9112	20.5483	20.0887	19.7215 (87)
Th 2	19.9766	19.9794	19.9821	19.9951	19.9976	20.0089	20.0089	20.0110	20.0045	19.9976	19.9926	19.9875 (88)
util rest of house	0.9939	0.9873	0.9699	0.9064	0.7611	0.5387	0.3617	0.4107	0.6964	0.9367	0.9867	0.9950 (89)
MIT 2	18.5219	18.7525	19.1022	19.5689	19.8704	19.9925	20.0073	20.0079	19.9460	19.5508	18.9746	18.5023 (90)
Living area fraction									fLA = Living area /	(4) =		0.2160 (91)
MIT	18.7857	19.0053	19.3391	19.7858	20.0809	20.2038	20.2206	20.2203	20.1545	19.7663	19.2153	18.7657 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7857	19.0053	19.3391	19.7858	20.0809	20.2038	20.2206	20.2203	20.1545	19.7663	19.2153	18.7657 (93)

8. Space heating requirement												

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9913	0.9832	0.9637	0.9006	0.7661	0.5563	0.3837	0.4337	0.7096	0.9310	0.9827	0.9929 (94)
Useful gains	579.6794	653.6422	706.1438	741.0828	672.0997	483.3709	318.3804	334.0869	499.0501	576.0024	561.8200	557.1313 (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	1325.6395	1286.8718	1167.8173	976.0959	749.4605	494.8146	319.7031	336.5402	537.2363	819.6996	1089.3316	1317.0988 (97)
Space heating kWh	554.9943	425.5303	343.4850	169.2094	57.5564	0.0000	0.0000	0.0000	0.0000	181.3107	379.8083	565.4158 (98a)
Space heating requirement - total per year (kWh/year)												2677.3103
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	554.9943	425.5303	343.4850	169.2094	57.5564	0.0000	0.0000	0.0000	0.0000	181.3107	379.8083	565.4158 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2677.3103
Space heating per m2										(98c) / (4) =		33.0532 (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	554.9943	425.5303	343.4850	169.2094	57.5564	0.0000	0.0000	0.0000	0.0000	181.3107	379.8083	565.4158 (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)	600.6432	460.5306	371.7371	183.1271	62.2905	0.0000	0.0000	0.0000	0.0000	196.2238	411.0480	611.9219 (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	233.5672	206.5734	219.7317	194.1145	188.7321	170.6976	169.0428	175.4768	177.0687	196.6598	208.1036	231.1620 (64)
Efficiency of water heater (217)m	86.1666	85.8937	85.3345	84.0885	82.1573	80.3000	80.3000	80.3000	80.3000	84.2076	85.6529	86.2203 (217)
Fuel for water heating, kWh/month	271.0645	240.4989	257.4947	230.8455	229.7203	212.5748	210.5140	218.5266	220.5090	233.5415	242.9615	268.1061 (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	24.4290	19.5979	17.6457	12.9280	9.9860	8.1586	9.1095	11.8409	15.3802	20.1796	22.7928	25.1080 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-37.7277	-53.1009	-76.2002	-85.5262	-92.0932	-85.9068	-84.8410	-80.1586	-71.8733	-60.6481	-41.4448	-32.6278 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-21.5723	-45.3564	-90.1086	-135.2810	-178.8252	-179.6652	-177.5540	-150.3586	-110.2384	-64.8483	-28.7967	-17.0609 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2897.5219 (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												2836.3574 (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)												197.1563 (232)

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

PV generation	-2001.8140 (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	4015.2217 (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	2897.5219	0.2100	608.4796 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2836.3574	0.2100	595.6351 (264)
Space and water heating			1204.1147 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	197.1563	0.1443	28.4557 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-802.1485	0.1346	-107.9880
PV Unit electricity exported	-1199.6654	0.1259	-151.0471
Total			-259.0351 (269)
Total CO2, kg/year			985.4646 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.1700 (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	2897.5219	1.1300	3274.1998 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2836.3574	1.1300	3205.0839 (278)
Space and water heating			6479.2837 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	197.1563	1.5338	302.4049 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-802.1485	1.4975	-1201.2558
PV Unit electricity exported	-1199.6654	0.4622	-554.4472
Total			-1755.7030 (283)
Total Primary energy kWh/year			5156.0864 (286)
Target Primary Energy Rate (TPER)			63.6600 (287)