Anderson Goddard Ltd

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Independent Energy Specialists, SAP, SBEM, EPC's, U-Value & Condensation Risk, 2D & 3D Thermal Modelling

West Street, Worsbrough, BARNSLEY, S70 5DJ

Energy Statement
&
Regulation 25a Low or Zero Carbon (LZC) Report

AG-77376-LZCR-Rev A

16th November 2023

Abacus House, 450 Warrington Road, Culcheth, Cheshire, WA3 5QX

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1. Executive Summary

This report has considered the use of high efficiency alternative heating systems in line with the requirements of Regulation 25a, Approved Document Part L Volume 1 of the building regulations (England) 2021.

The proposed fabric and mechanical specification from Table 2 and Table 3 shown on page 6 of this report will achieve a compliance with AD. L1 2021 building regulations of which fabric and PV technology will provide the following reductions in energy, primary energy over and above the requirements of Part L 2021 and a 36.54% reduction in Carbon emissions over and above AD. L1 2013 requirements (Regulated use).

Regulated use

Energy (Consumption)	2.27%
Primary Energy (Total energy)	3.55%
Carbon emissions	4.80% (AD. Part L1 2021)
Carbon emissions	**35.80% (AD. Part L1 2013)**

Total use

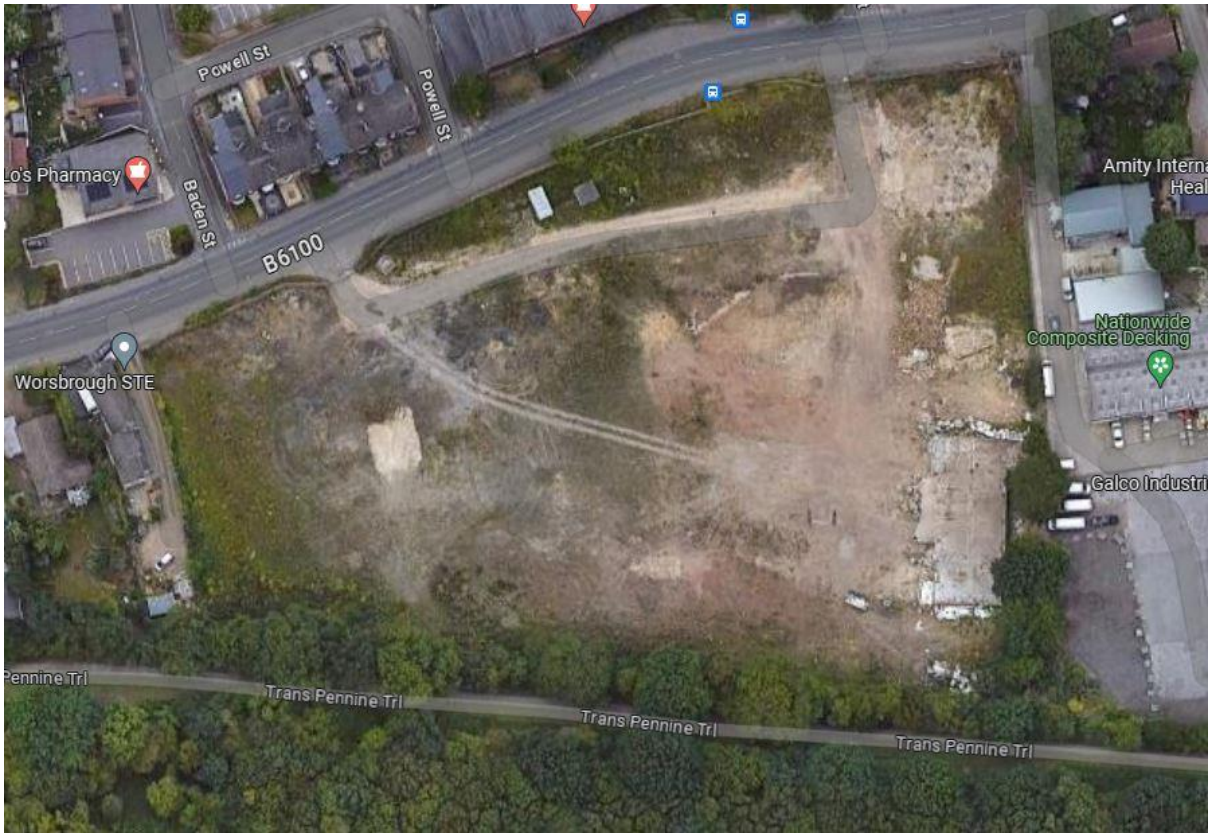
Energy (Consumption)	1.26%
Primary Energy (Total energy)	1.84%
Carbon emissions	3.31%

Proposed Solution

The proposed solution is to use Photovoltaic technology to meet the regulatory requirements of Approved Document Part L Volume 1 of the Building Regulations 2021. Photovoltaic technology has been chosen to reduce running costs and achieve an Energy Performance Certificate “A” rating.

2. The development

The residential development at West Street, Worsbrough, BARNSLEY, S70 5DJ comprises a total of 51 dwellings which are to achieve compliance with approved document Part L1 of the building regulations 2021.



2.1. Housing mix

House types	Number	Area m²	Total area m²
HT736	16	72.46	1159.36
HT847	16	83.46	1335.36
HT889	8	87.58	700.64
HT980	4	96.10	384.40
HT1280	7	126.46	885.22
Total	51		4464.98

2.2. Proposed specification & assessment

The objective of this section of the report is to provide more information on specific requirements and details of the proposed fabric and heating and solutions, from this initial assessment and specific technical requirements a detailed heating design will need to be provided by a specialist who may be required to work with manufacturers. Technical information from the manufacturers will be included as an Appendix to this main report when available.

Table 2: Proposed fabric specification			
Roof		0.10	W/m² K
Walls		0.18	W/m² K
Floor		0.11	W/m² K
Windows		1.20	W/m² K
Doors		1.00	W/m² K
Lintels	Hi-Therm lintels		
Thermal Bridging	Modelled Thermal bridging details		
Air permeability			5 m²

Table 3: Mechanical Specification	
Heating	Highly efficient gas boilers
Controls	Programmer, Room Thermostat & TRV's
Domestic Hot Water	From main system
Compensator	Delayed start thermostat
Ventilation	Decentralised, Mechanical Extract Ventilation dMEV
Lighting	80lumes / watt
Photovoltaic Panels	PV panels installed to all dwellings

House types	Number	PV estimate Kw Peak
HT736	16	2.00
HT847	16	2.40
HT889	8	2.40
HT980	4	2.00
HT1280	7	4.80

Energy, Primary Energy, Carbon and running costs based current proposals

Development (Proposed)	m²
GIFA (Development)	4464.98
Energy	**KwH**
Heating	144,550.22
Hot water	130,361.96
Fans and Pumps	6,518.36
Lighting	12,041.68
Appliances	136,670.12
Cooking	28,716.64
Total Energy use	458,858.98
Energy Kw per m² of floor area	102.77
Energy (Primary)	**Kwpe**
Heating	163,341.75
Hot water	147,309.01
Fans and Pumps	9,784.06
Lighting	18,074.56
Appliances	205,141.85
Cooking	43,103.67
Total Energy use	586,754.91
Energy Kw per m² of floor area	131.41
CO2 emissions	**Kg CO2**
Heating	30,355.55
Hot water	27,376.01
Fans and Pumps	886.50
Lighting	1,637.67
Appliances	18,587.14
Cooking	3,905.46
Total CO2 emissions	82,748.32
Annual predicted carbon emissions per m² of floor area	18.53
Running Cost	**£ pa**
Heating	£ 10,841.27
Hot water	£ 9,777.15
Fans and Pumps	£ 2,020.69
Lighting	£ 3,732.92
Appliances	£ 42,367.74
Cooking	£ 8,902.16
Standing Charges	£ 13,507.04
Total Running Costs	£ 91,148.97
Average annual Running Costs per residential unit	£ 1,787.23

Estimated fuel costs are based on the Government price cap figures from July 2023, running costs are for comparison purposes and actual running costs may differ depending on actual use.

2.3. Reduction in Carbon, Energy from improved fabric and mechanical specification

Energy (KwH)	NOTIONAL	PROPOSED
Heating	152,880.06	144,550.22
Hot water	145,952.43	130,361.96
Fans and Pumps	4,386.00	6,518.36
Lighting	10,340.95	12,041.68
Appliances	136,670.12	136,670.12
Cooking	28,716.64	28,716.64
Photovoltaic (electricity used in dwelling)	-42,736.70	-38,091.20
Photovoltaic (electricity exported)	-64,907.20	-54,132.71
Total	371,302.30	366,635.07
Reduction in energy		4667.23
Percentage reduction		1.26%

Energy Primary (Kwpe)	NOTIONAL	PROPOSED
Heating	172,754.47	163,341.75
Hot water	164,926.25	147,309.01
Fans and Pumps	6,583.39	9,784.06
Lighting	15,521.77	18,074.56
Appliances	205,141.85	205,141.85
Cooking	43,103.67	43,103.67
Photovoltaic (electricity used in dwelling)	-64,147.79	-57,174.89
Photovoltaic (electricity exported)	-29,208.24	-24,359.72
Total	514,675.36	505,220.30
Reduction in energy		9455.07
Percentage reduction		1.84%

Carbon emissions (Kg/CO2)	NOTIONAL	PROPOSED
Heating	32,104.81	30,355.55
Hot water	30,650.01	27,376.01
Fans and Pumps	596.50	886.50
Lighting	1,406.37	1,637.67
Appliances	18,587.14	18,587.14
Cooking	3,905.46	3,905.46
Photovoltaic (electricity used in dwelling)	-5,812.19	-5,180.40
Photovoltaic (electricity exported)	-8,827.38	-7,362.05
Total	72,610.72	70,205.87
Reduction in Carbon emissions		2404.85
Percentage reduction		3.31%

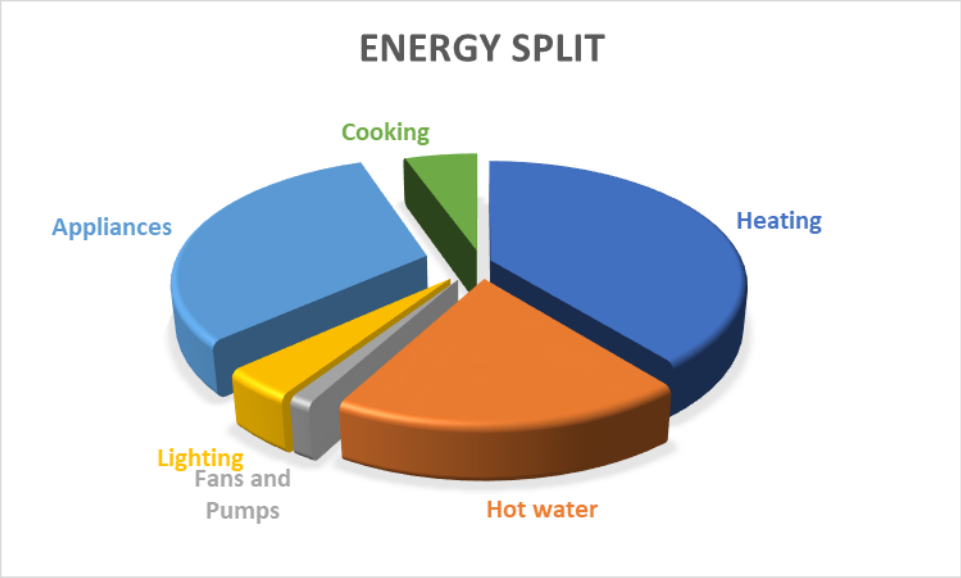
Reduction from renewable technology

Energy	Kwh
Heating	144,550.22
Hot water	130,361.96
Fans and Pumps	6,518.36
Lighting	12,041.68
Appliances	136,670.12
Cooking	28,716.64
Sub TOTAL	458,858.98
Reduction in energy through LZC technology	-92,223.91
Total	366,635.07
Percentage reduction	20.10%

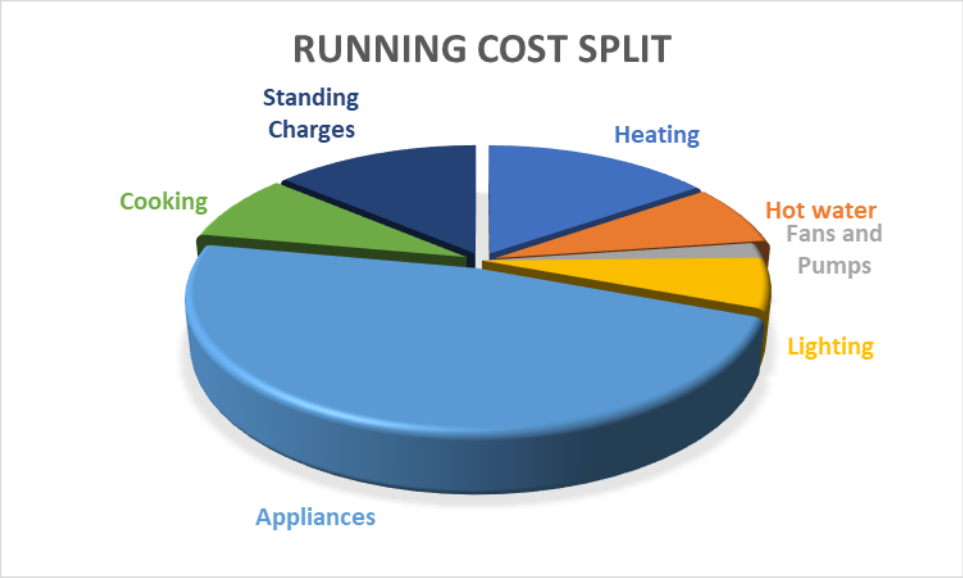
Energy (Primary)	Kwpe
Heating	163,341.75
Hot water	147,309.01
Fans and Pumps	9,784.06
Lighting	18,074.56
Appliances	205,141.85
Cooking	43,103.67
Sub TOTAL	586,754.91
Reduction in PRIMARY energy through LZC technology	-81,534.61
Total	505,220.30
Percentage reduction	13.90%

Carbon emissions	Kg/CO2
Heating	30,355.55
Hot water	27,376.01
Fans and Pumps	886.50
Lighting	1,637.67
Appliances	18,587.14
Cooking	3,905.46
Sub TOTAL	82,748.32
Reduction in Carbon emissions through LZC technology	-12,542.45
Total	70,205.87
Percentage reduction	15.16%

Total energy consumption split by use

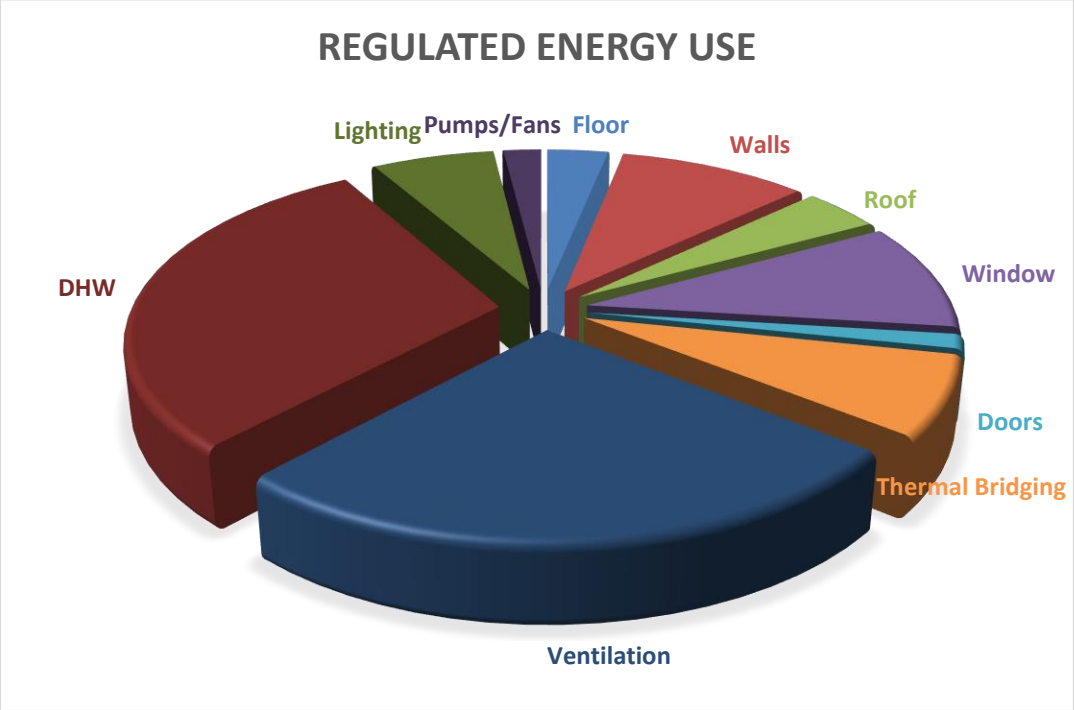


Total running cost split by use (Post April 2022 price cap)



2.4. Fabric (Be Lean)

Split of fabric losses in an average semidetached House with GIFA of 121m² dwelling built to AD. L1 2021 fabric specification (Notional dwelling, please refer to Table 1.1 on Page 17 of this report)



The affects from fabric improvements represent an approximately 25% of the total energy requirements from a typical new build home built to 2013/2021 building regulations standard and approximately 50% of regulated emissions (excluding use .i.e. cooking and appliances) as assessed using steady state assessment methodologies such as SAP etc. Improvements to individual fabric elements can have very limited effect on Energy/Carbon reduction although this is not a reason not to reduce heat loss and reduce heating loads by improving fabric and reducing losses associated with thermal bridging and ventilation losses.

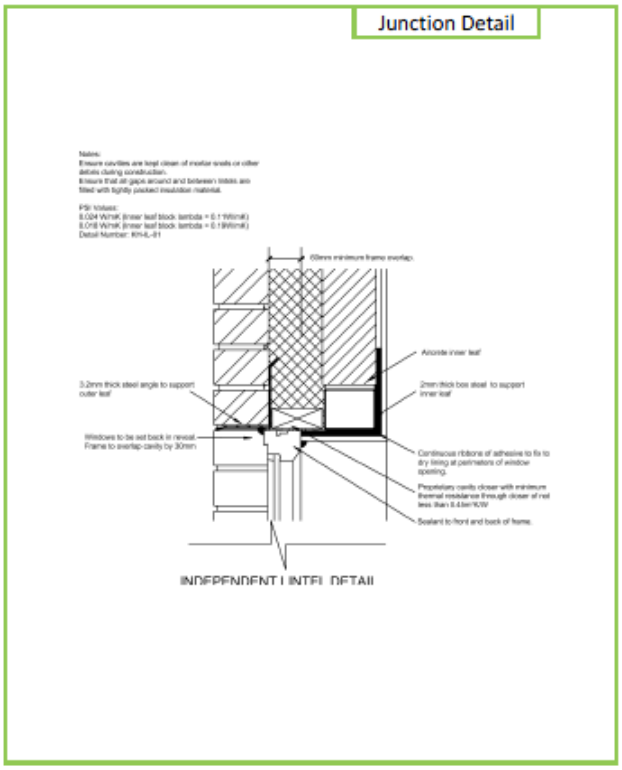
Future retro improvements made to a building's fabric are expensive, disruptive and most of the time impractical and therefore the thermal qualities of the building fabric must be one of the main considerations for long term energy and CO_2 reduction.

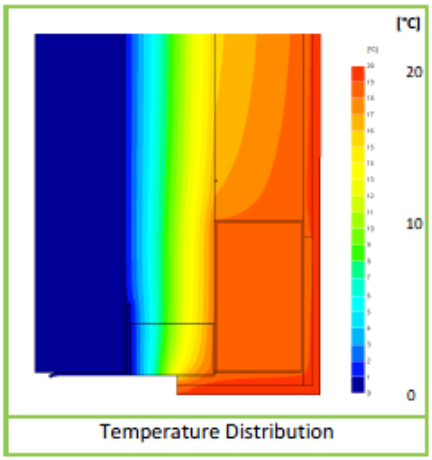
Reducing Energy and Carbon emissions from a development by increasing the fabric specification provides the development with a high degree of longevity, by limiting the heat losses across the building envelope over the dwelling's lifetime.

Improving the fabric specification at design stage will ensure that these dwellings do not become the "hard to treat dwellings" of the future.

It can be seen that thermal bridging will contribute to over 15% of a dwellings heating requirements, loses associated from junctions have been considered in detail and have been improved through modelling by the use of specialist 2D/3D thermal modelling software to BR433. Areas of high thermal loss will be identified and improved as required.

Example of a window lintel detail

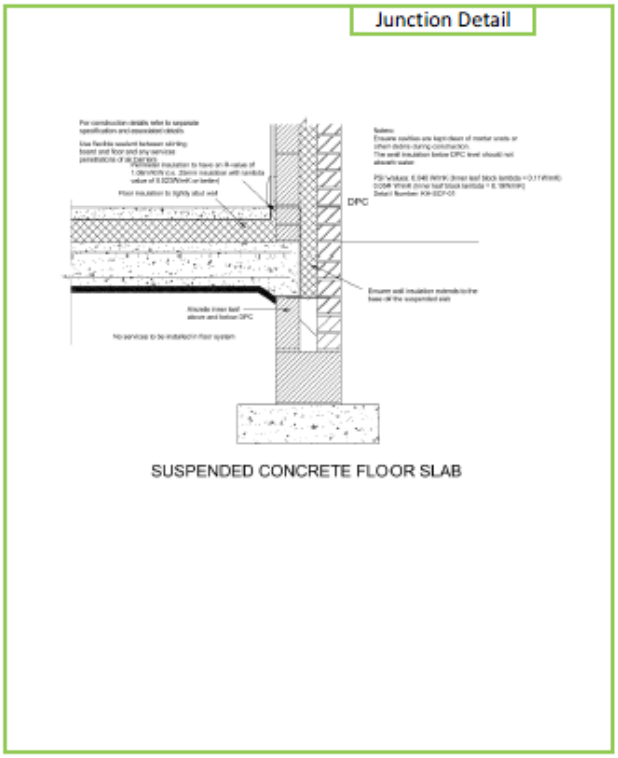


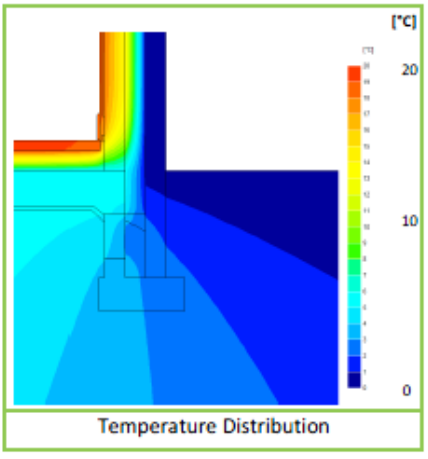


Linear Thermal Transmittance W/m.K	
Ψ =	0.018

Temperature Factor[3] for Humidity and Mould	
f =	0.939

Example of an exposed ground floor / wall bridging detail.





Linear Thermal Transmittance W/m.K	
Ψ =	0.040

Temperature Factor[3] for Humidity and Mould	
f =	0.924

3. Introduction

Anderson Goddard Ltd has been commissioned by Hoober Homes to provide an Energy Statement and Low or Zero Carbon (LZC) feasibility assessment for the proposed development at West Street, Worsbrough, BARNSLEY, S70 5DJ. This report will consider the requirements of compliance with the building regulations in terms of Carbon and Primary Energy metrics and will also consider the use of high efficiency alternative systems in line with the requirements of Regulation 25a, Approved Document Part L1 of the building regulations (England) 2021.

The following will be considered.

- Energy generated from the LZC technology
- Payback
- Land use
- Local planning requirements
- Noise
- Whole life costs and lifecycle impact of the potential specification in terms of carbon emissions
- Any available grants
- All technologies appropriate to the site and energy demand of the development
- Reasons for excluding other technologies

3.1 Assessment methodology

The following methodologies approved documentation and practices have been used in the compilation of this report.

- SAP 10.2
- Approved document Part L1 of the building regulations 2021

SAP, the governments "Standard Assessment Procedure" for calculating the energy performance of a dwelling and is used primarily for the purpose of satisfying approved document Part L1 of the Building regulations 2021

Appliances

The second part of the calculation takes into account electrical use from appliances ref appendix L2 SAP 2012

$E_a = 207.8 \times (TFA \times N)^{0.4714}$

$E_a \times EF_{electricity} / TFA$

Were TFA is the total floor area in m² and N is the assumed number of occupants

Cooking

(119 + 24N)/TFA

Where TFA is the total floor area and N is the number of occupants
All assessments of benefit in terms of CO_2 reduction provided by upgrade measures or LZC technologies including heating and innovative technologies will be assessed as a percentage of the total estimated CO_2 emissions which will include heating, ventilation, lighting, pumps and fans from SAP 2005 and also CO_2 emissions provided by the calculation process above for Cooking and appliances.

Regulated Use

- Heating
- Ventilation
- Lighting
- Pumps and fans

Un-Regulated use

- Cooking
- Appliances

A SAP calculation generates four ratings a SAP rating and potential SAP rating and Environmental Impact (EI) rating and potential EI rating, all ratings are out of 100.

A SAP rating is an indication of heating and lighting costs, the higher the rating the lower the fuel costs will be.

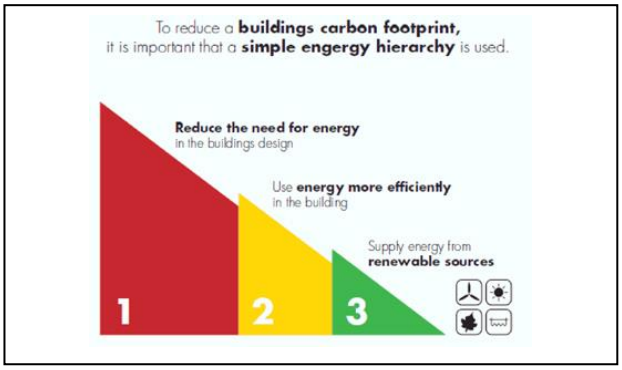
Environmental Impact (EI) rating is an indication of CO_2 emissions produced by heating and lighting, the higher the rating the lower the Carbon emissions will be.

3.2 Energy Hierarchy

In line with best practice, the proposed buildings energy strategy should adhere to the principles of the Energy Hierarchy.

- **Be Lean** – reduce the need for energy.
- **Be Clean** – supply and use energy in the most efficient manner.
- **Be Green** – supply energy from renewable sources.

The Energy Hierarchy



Adhering to the principles of the Energy Hierarchy has a number of benefits.

- By reducing the energy requirement of the building, the burden of renewable requirement shrinks in proportion. This has obvious financial benefits and will help meet part L of building regulations and any further reductions in carbon emissions required.

- The sustainable credentials of the development are enhanced and are not validated by simply bolting on expensive renewable equipment. By focusing on fabric performance and the provision of efficient heating/cooling systems the building is intrinsically "green".

The lean measures are those measures which cumulatively reduce the energy requirement of the development through the construction of a thermally efficient building envelope. The measures included in this section of the report constitute the lean efforts.

"Fabric First"

Improved fabric specification

Fabric Enhancements are shown on Page 9 – Be-Lean

High efficient technologies

High efficiency heating technology such as heat pumps will have the greatest effect on reducing carbon emissions.

Energy efficiency within the building – Be Clean

Renewables

Microgeneration technologies including Photovoltaic technology will have the largest benefit in reducing occupiers running costs and reducing Primary Energy.

Installation of Renewable Energy – Be Green

LZC technology

An assessment of renewable technologies has taken place to determine technical and financial viability.

The following technologies would not be technically viable and/or would not provide the required reduction in either CO_2 emissions or energy.

- Solar thermal
- Micro wind
- District heating, CHP

Heat pump technology

Pros

- Would provide the largest reduction in carbon emissions when compared to other LZC technologies
- Maintenance requirements would be lower than more conventional systems

Cons

- Would require additional land use
- May be noisy in operation
- Would be more expensive to operate compared to more conventional systems

Photovoltaic

Pros

- Would provide the most cost-effective solution from a lifetime cost perspective as compared to other technologies
- Dwellings installed with Photovoltaic panels will have an Energy Performance Rating of 'A'
- Would provide the largest reduction in fuel costs as experienced by the occupant
- Would provide high reduction in energy
- Would not require any user operation
- Would require minimal change of habit by the occupant
- Would be silent in operation
- Would require very little maintenance when compared against other LZC technologies

Cons

- Would require suitable roof orientation and configurations, site layout etc
- Would have minimal effect on reducing carbon emissions when compared to Heat Pump technology

3.3 Building regulation requirements

Approved Document Part L1 of the Building Regulations 2021 (England)

Regulation 25

Regulation 25 requires the Secretary of State to approve minimum energy performance requirements. These requirements are in the form of a target primary energy rate, a target emission rate and a target fabric energy efficiency rate.

The targets are set out in Section 1 of this approved document.

Regulations 26, 26A and 26C

A newly constructed dwelling must be shown to meet regulations 26, 26A and 26C by producing calculations to show that the dwelling meets all of the following.

a. Target primary energy rate.

b. Target emission rate.

c. Target fabric energy efficiency rate.

Section 2 of this approved document sets out how to produce these calculations.

Regulations 27, 27A and 27C

Both before and after a newly constructed dwelling is built, a notice must be given to the building control body of the calculations.

Regulation 25A: Consideration of high-efficiency alternative systems

This section deals with the requirements of regulation 25A of the Building Regulations 2010.

Regulation

Consideration of high-efficiency alternative systems for new buildings

25A. (1) Before construction of a new building starts, the person who is to carry out the work must analyse and take into account the technical, environmental and economic feasibility of using high-efficiency alternative systems (such as the following systems) in the construction, if available—

(a) decentralised energy supply systems based on energy from renewable sources;

(b) cogeneration;

(c) district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources; and

(d) heat pumps.

(2) The person carrying out the work must—

(a) not later than the beginning of the day before the day on which the work starts, give the local authority a notice which states that the analysis referred to in paragraph (1)—

(i) has been undertaken;

(ii) is documented; and

(iii) the documentation is available to the authority for verification purposes; and

(b) ensure that a copy of the analysis is available for inspection at all reasonable times upon request by an officer of the local authority.

(3) An authorised officer of the local authority may require production of the documentation in order to verify that this regulation has been complied with.

(4) The analysis referred to in paragraph (1)—

(a) may be carried out for individual buildings or for groups of similar buildings or for common typologies of buildings in the same area; and

(b) in so far as it relates to collective heating and cooling systems, may be carried out for all buildings connected to the system in the same area.

Regulation *continued*

(5) In this regulation—

(a) "cogeneration" means simultaneous generation in one process of thermal energy and one or both of the following—

(i) electrical energy;

(ii) mechanical energy;

(b) "district or block heating or cooling" means the distribution of thermal energy in the form of steam, hot water or chilled liquids, from a central source of production through a network of multiple buildings or sites, for the use of space or process heating or cooling;

(c) "energy from renewable sources" means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases; and

(d) "heat pump" means a machine, a device or installation that transfers heat from natural surroundings such as air, water or ground to buildings or industrial applications by reversing the natural flow of heat such that it flows from a lower to a higher temperature. (For reversible heat pumps, it may also move heat from the building to the natural surroundings.)

Table 1.1 Summary of notional dwelling specification for new dwelling[1]

Element or system	Reference value for target setting
Opening areas (windows, roof windows, rooflights and doors)	Same as for actual dwelling not exceeding a total area of openings of 25% of total floor area[2]
External walls including semi-exposed walls	U = 0.18 W/(m²·K)
Party walls	U = 0
Floors	U = 0.13 W/(m²·K)
Roofs	U = 0.11 W/(m²·K)
Opaque door (less than 30% glazed area)	U = 1.0 W/(m²·K)
Semi-glazed door (30–60% glazed area)	U = 1.0 W/(m²·K)
Windows and glazed doors with greater than 60% glazed area	U = 1.2 W/(m²·K) Frame factor = 0.7
Roof windows	U = 1.2 W/(m²·K), when in vertical position (for correction due to angle, see specification in SAP 10 Appendix R)
Rooflights	U = 1.7 W/(m²·K), when in horizontal position (for correction due to angle, see specification in SAP 10 Appendix R)
Ventilation system	Natural ventilation with intermittent extract fans
Air permeability	5 m³/(h·m²) at 50 Pa
Main heating fuel (space and water)	Mains gas
Heating system	Boiler and radiators Central heating pump 2013 or later, in heated space Design flow temperature = 55 °C
Boiler	Efficiency, SEDBUK 2009 = 89.5%
Heating system controls	Boiler interlock, ErP Class V Either: – single storey dwelling in which the living area is greater than 70% of the total floor area: programmer and room thermostat – any other dwelling: time and temperature zone control, thermostatic radiator valves
Hot water system	Heated by boiler (regular or combi as above) Separate time control for space and water heating
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98
Hot water cylinder	If cylinder, declared loss factor = 0.85 x (0.2 + 0.051 $V^{2/3}$) kWh/day where V is the volume of the cylinder in litres
Lighting	Fixed lighting capacity (lm) = 185 x total floor area Efficacy of all fixed lighting = 80 lm/W
Air conditioning	None
Photovoltaic (PV) system	For houses: kWp = 40% of ground floor area, including unheated spaces / 6.5 For flats: kWp = 40% of dwelling floor area / (6.5 x number of storeys in block) System facing south-east or south-west

NOTE:

1. For a dwelling connected to an existing district heat network, an alternative notional building is used. See paragraph 1.8 and SAP 10.
2. See SAP 10 for details.

4 Low or Zero Carbon overview

The following Low or Zero Carbon technologies are commercially available for use in the UK housing sector; the following overview will give a brief description of each technology which will provide a better understanding of how each technology works and its appropriation for use, either for use in this project or for future projects.

Low or zero carbon technologies available in the UK

Zero carbon technologies

- Solar Hot Water
- Solar Photovoltaic
- PV-Thermal
- Small scale hydro power
- Wind turbines
- Solar Air heating

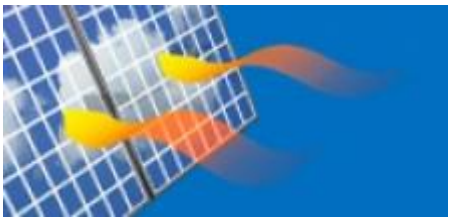
Low carbon technologies

- Biomass
- Combined Heat and Power (CHP) and micro CHP
- Community heating, including utilising waste heat from processes such as large scale power generation where the majority of heating comes from waste heat
- Heat pumps, Ground source heat pumps (GSHP) Geothermic heating systems, Air source.
- Other technologies, Fuel cells using hydrogen from any of the above renewable sources

Other innovative technologies

- Flue Gas Heat recovery systems (FGHRS)
- Shower saver Waste Water Heat Recovery (WWHRS)
- Sunwarm
- Geothermic storage

4.1 Solar Water



Solar water heating systems use heat from the sun to work alongside conventional primary water heaters. The technology is well developed with a large choice of equipment to suit many applications.
For domestic hot water there are three main components
Solar panels or collectors - are fitted to your roof. They collect heat from the sun's radiation. There are 2 main types of collector:
Flat plate systems - which are comprised of an absorber plate with a transparent cover to collect the sun's heat, or
Evacuated tube systems - which are comprised of a row of glass tubes that each contains an absorber plate feeding into a manifold which transports the heated fluid.
A heat transfer system - uses the collected heat to heat water;
Hot water cylinder - stores the hot water that is heated during the day and supplies it for use later.

Fuel Displaced	£ Saving per year	CO2 saving per year
Gas	£50	325 kg
Electricity	£80	635 kg
Oil	£65	365 kg
Solid	£55	645 kg

All savings are approximate and are based on the hot water heating requirements of a 3 bed semidetached home.
Solar water heating can be used in the home or for larger applications, such as swimming pools. For a domestic system you will need 3-4 square metres of southeast to southwest facing roof receiving direct sunlight for the main part of the day, a space to locate an additional water cylinder if required.
In England, changes to permitted development rights for micro generation technologies introduced on 6th April 2008 have lifted the requirements for planning permission for most solar water heating installations. Roof mounted and stand-alone systems can now be installed in most dwellings, as long as they respect certain size criteria. Exceptions apply for Listed Buildings, and buildings in Conservation Areas and World Heritage Sites.
In Wales, Scotland and Northern Ireland, the devolved governments are currently all considering changes to their legislation on permitted developments, to facilitate installations of micro generation technologies, including solar water heating. Legislation is expected in all three countries later this year. Until then, householders in Wales, Scotland and Northern Ireland must consult with their local authority regarding planning permission.
Solar water heating systems tend to require little maintenance Installation and maintenance costs.

The typical installation cost for a domestic system is £3,000 - £5,000. Evacuated tube systems are more advanced in design than flat plate, and so tend to be more expensive.

Solar water heating systems generally come with a 5-10 year warranty and require regular maintenance. A yearly check by the householder and a more detailed check by a professional installer every 3-5 years should be sufficient.

4.2 Solar Photovoltaic

Solar PV (photovoltaic) uses energy from the sun to create electricity to run appliances and lighting.
PV requires only daylight - not direct sunlight - to generate electricity.

How it works

Photovoltaic systems use cells to convert solar radiation into electricity. The PV cell consists of one or two layers of a semi conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers, causing electricity to flow. The greater the intensity of the light, the greater the flow of electricity...PV systems generate no greenhouse gases, saving approximately 325kg of carbon dioxide emissions per year - adding up to about 8 tonnes over a system's lifetime - for each kilowatt peak (kWp - PV cells are referred to in terms of the amount of energy they generate in full sun light).
PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles, to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity. As well as enabling you to generate free electricity they can provide an interesting alternative to conventional roof tiles!
PV systems for a building with a roof or wall that faces within 90 degrees of south, as long as no other buildings or large trees overshadow it.
If the roof surface is in shadow for parts of the day, the output of the system decreases. Solar panels are not light and the roof must be strong enough to take their weight, especially if the panel is placed on top of existing tiles. Solar PV installations should always be carried out by a trained and experienced installer. The area of PV required to generate 1 kw hour peak varies but generally 6-8m² for Môn crystalline or 10² for polycrystalline modules of PV will produce 1 Kw peak of electricity.

Cost and maintenance

Prices for PV systems vary, depending on the size of the system to be installed, type of PV cell used and the nature of the actual building on which the PV is mounted. The size of the system is dictated by the amount of electricity required. For the average domestic system, costs can be around £4,000- £9,000 per kWp installed, with most domestic systems usually between 1.5 and 2 kWp. Solar tiles cost more than conventional panels, and panels that are integrated into a roof are more expensive than those that sit on top. Grid connected systems require very little maintenance, generally limited to ensuring that the panels are kept relatively clean and that shade from trees has not become a problem.
The wiring and components of the system should however be checked regularly by a qualified technician. Stand-alone systems, i.e. those not connected to the grid, need maintenance on other system components, such as batteries.

4.3 Solar PV / Thermal

PV-T is an integrated panel that produces both electricity and heat.

Benefit

Traditional PV systems produce heat as a bi product of the electric production which causes the PV collector to reduce in efficiency, as a rule of thumb a PV collector will reduce in efficiency by 0.5% for every 1°C increase in temperature above normal operating temperatures, PV temperatures can exceed 85°C. PV-T systems are designed to cool the collectors and use the collected heat for water and space heating.

How it works

By cooling the PV panel with either water or air the collector will operate up to 25% more efficiently resulting in a smaller area of PV required to generate the same amount of energy compared to a typical PV collector, the heated water or air can then be used to provide the dwelling with heating and or hot water depending on system design.

Cost and Maintenance

The cost of the PV-T system will be very similar to the combined cost of Solar thermal and solar PV and the technology is more suited to Code 5 or code 6 plots because of the reduced area of PV required which would free up available roof area.

4.4 Hydro

Hydro power systems use running water turning a turbine to produce electricity. A micro hydro plant is one that generates less than 100kW. Improvements in small turbine and generator technology mean that micro hydro schemes are an attractive means of producing electricity. Useful power may be produced from even a small stream.

Benefits

For houses with no mains connection but with access to a micro hydro site, a good hydro system can generate a steady, more reliable electricity supply than other renewable technologies at a lower cost. Total system costs can be high but often less than the cost of a grid connection and with no electricity bills to follow.
It should be noted that in off grid applications the power is used for lighting and electrical appliances. However, space and water heating can be supplied when available power exceeds demand.
Hydro power systems convert potential energy stored in water held at height to kinetic energy

How it works

Hydro power systems convert potential energy stored in water held at height to kinetic energy (or the energy used in movement) to turn a turbine to produce electricity.
Energy available in a body of water depends on the water's flow rate and the height (or head) that the water falls. These are divided into low head, medium head and high head, where the height drop is greater. The scheme's actual output will depend on how efficiently it converts the power of the water into electrical power (maximum efficiencies of over 90% are possible but for small systems 60 - 80% is more realistic).
Hydro power requires the source to be relatively close to where the power will be used or to a suitable grid connection. Hydro systems can be connected to the main electricity grid or as a part of a standalone (off grid) power system. In a grid connected system, any electricity generated but not used can be sold to electricity companies.
In an off grid hydro system, electricity can be supplied directly to the devices powered or through a battery bank and inverter set up. A back up power system may be needed to compensate for seasonal variations in water flow.

Costs and savings

Hydro costs are very site specific and are related to energy output. For low head systems (assuming there is an existing pond or weir), costs may be in the region of £4,000 per kW installed up to about 10kW and would drop per kW for larger schemes.
For medium heads, there is a fixed cost of about £10,000 and then about £2,500 per kW up to around 10kW - so a typical 5kW domestic scheme might cost £20-£25,000. Unit costs drop for larger schemes. Maintenance costs vary but small scale hydro systems are very reliable.

4.5 Micro wind

Wind turbines use the wind's lift forces to rotate aerodynamic blades that turn a rotor which creates electricity. In the UK we have 40% of Europe's total wind energy. But it's still largely untapped and only 0.5% of our electricity requirements are currently generated by wind power.
How does it work? Most small wind turbines generate direct current (DC) electricity. Systems that are not connected to the national grid require battery storage and an inverter to convert DC electricity to AC (alternating current - mains electricity).
Wind systems can also be connected to the national electricity grid. A special inverter and controller convert DC electricity to AC at a quality and standard acceptable to the grid. No battery storage is required. Any unused or excess electricity may be able to be exported to the grid and sold to the local electricity supply company.
There are two types of wind turbines:
Mast mounted - which are free standing and located near the building(s) that will be using the electricity.
Roof mounted - which can be installed on house roofs and other buildings.

Benefits

Wind power is a clean, renewable source of energy which produces no carbon dioxide emissions or waste products.
In the UK we have 40% of Europe's total wind energy
Individual turbines vary in size and power output from a few hundred watts to two or three megawatts (as a guide, a typical domestic system would be 1 - 6 kilowatts). Uses range from very small turbines supplying energy for battery charging systems (e.g. on boats or in homes), to turbines on wind farms supplying electricity to the grid.
You should consider the following issues if you're thinking about small scale wind. An accredited installer will be able to provide more detailed advice. Wind speed increases with height so it's best to have the turbine high on a mast or tower.
Generally speaking the ideal site is a smooth top hill with a flat, clear exposure, free from excessive turbulence and obstructions such as large trees, houses or other buildings.
Small scale wind power is particularly suitable for remote off grid locations where conventional methods of supply are expensive or impractical. Please note that the electricity generated at any one time by a wind turbine is highly dependent on the speed and direction of the wind. The wind speed itself is dependent on a number of factors, such as location within the UK, height of the turbine above ground level and nearby obstructions. Ideally, you should undertake a professional assessment of the local wind speed for a full year at the exact location where you plan to install a turbine before proceeding. In practice, this may be difficult, expensive and time consuming to undertake. Therefore I recommend that, if you are considering a domestic building mounted installation and electricity generation is your main motivation, then you only consider a wind turbine under the following circumstances:
The local annual average wind speed is 6 m/s or more. There are no significant nearby obstacles such as buildings, trees or hills that are likely to reduce the wind speed or increase turbulence

Planning issues such as visual impact, noise and conservation issues also have to be considered. System installation normally requires permission from the local authority.

Roof mounted

These cost from £3000.The amount of energy and carbon that roof top micro wind turbines save depends on several things including size, location, wind speed, nearby buildings and the local landscape. At the moment there is not enough data from existing wind turbine installations to provide a figure of how much energy and carbon could typically be saved. The Energy Saving Trust is monitoring up to 100 wind turbine installations; the results of this activity will help to provide further information for householders considering this technology.

Mast mounted

Larger systems in the region of 2.5kW to 6kW would cost between £11,000 - £19,000 installed. These costs are inclusive of the turbine, mast, inverters, battery storage (if required) and installation; however it's important to remember that costs always vary depending on location and the size and type of system. Turbines can have a life of up to 22.5 years but require service checks every few years to ensure they work efficiently. For battery storage systems, typical battery life is around 6-10 years, depending on the type, so batteries may have to be replaced at some point in the system's life.

4.6 Bio Mass

Biomass is produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. It is often called 'bio energy' or 'bio fuels'. It doesn't include fossil fuels, which have taken millions of years to be created.
Biomass fall into two main categories:
Woody biomass includes forest products, untreated wood products, energy crops and short rotation coppice (SRC), which are quick-growing trees like willow.
Non-woody biomass includes animal waste, industrial and biodegradable municipal products from food processing and high energy crops. Examples are rape, sugar cane, maize.
For small-scale domestic applications of biomass the fuel usually takes the form of wood pellets, wood chips or wood logs

The benefits

Producing energy from biomass has both environmental and economic advantages.
Although biomass produces CO2 it only releases the same amount that it absorbed whilst growing, which is why it is considered to be carbon neutral. Furthermore, biomass can contribute to waste management by harnessing energy from products that are often disposed of at landfill sites.
It is most cost effective and sustainable when a local fuel source is used, which results in local investment and employment and also minimises transport miles to your home.

Fuel

It's important to have storage space for the fuel, appropriate access to the boiler for loading and a local fuel supplier.

Flue

The vent material must be specifically designed for wood fuel appliances and there must be sufficient air movement for proper operation of the stove. Chimneys can be fitted with a lined flue.
Regulations
The installation must comply with all safety and building regulations.
See Part L of the Building Regulations, Northern Ireland
See Section 3 of the Technical Handbooks, Scotland

Smokeless zones

Wood can only be burnt in exempted appliances, under the Clean Air Act.

Planning

If the building is listed or in an area of outstanding natural beauty (AONB), then you will need to check with your Local Authority Planning Department before a flue is fitted.

Costs and savings

Standalone room heaters generally cost £2,000 to £4,000 installed. Savings will depend on how much they are used and which fuel you are replacing. A biomass stove which provides a detached home with 10% of annual space heating requirements could save around 840kg of carbon dioxide when installed in an electrically heated home. Due to the higher cost of biomass pellets compared with other traditional heating fuels, and the relatively low efficiency of the stove compared to a central heating system it will cost more to run.

The cost for boilers varies depending on the system choice; a typical 15kW (average size required for a three-bedroom semidetached house) pellet boiler would cost around £5,000 - £14,000 installed, including the cost of the flue and commissioning. A manual log feed system of the same size would be slightly cheaper. A wood pellet boiler could save you around £750 a year in energy bills and around 6 tonnes of C02 per year when installed in an electrically heated home.

Unlike other forms of renewable energy, biomass systems require you to pay for the fuel. Fuel costs generally depend on the distance from your supplier and whether you can buy in large quantities.

4.7 Heat Pumps

There are two types of heat pumps, ground source and air source.
Heat pumps work in a very similar way to fridges and air conditioners and absorb heat from the ground or from the air.
Ground or air source heat pumps are mainly designed to work with under floor heating systems because of the lower design temperatures of under floor systems.
Efficiencies of ground source heat pumps are between 350%-400% and air source between 200%-250%.

Heat pumps are a viable alternative to electric, LPG and oil fuel boilers, but are not considered as an alternative to natural gas.

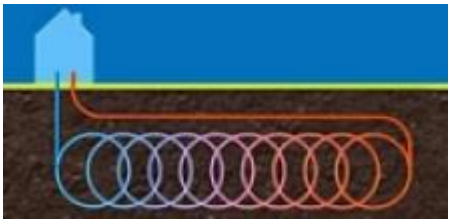
Ground source heat pumps

Ground source heat pumps use a buried ground loop which transfers heat from the ground into a building to provide space heating and, in some cases, to pre-heat domestic hot water. As well as ground source heat pumps, air source and water source heat pumps are also available.

The benefits

The efficiency of a ground source heat pump system is measured by the coefficient of performance (CoP). This is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Average CoP over the year, known as seasonal efficiency, is around 3-4 although some systems may produce a greater rate of efficiency. This means that for every unit of electricity used to pump the heat, 3-4 units of heat are produced, making it an efficient way of heating a building. If grid electricity is used for the compressor and pump, then you should consult a range of energy suppliers to benefit from the lowest running costs, for example by choosing an economy 10 or economy 7 tariff.

Ground source heat pumps



How it works

There are three important elements to a ground source heat pump:

1. **The ground loop**
   This is comprised of lengths of pipe buried in the ground, either in a borehole or a horizontal trench. The pipe is usually a closed circuit and is filled with a mixture of water and antifreeze, which is pumped around the pipe absorbing heat from the ground. The ground loop can be:
   - Vertical, for use in boreholes
   - Horizontal, for use in trenches
   - Spiral, coil or 'slinky', also for use in trenches
2. **A heat pump**
   In the same way that your fridge uses refrigerant to extract heat from the inside, keeping your food cool, a ground source heat pump extracts heat from the ground, and uses it to heat your home. A ground source heat pump has three main parts:
   - The evaporator, (e.g. the squiggly thing in the cold part of your fridge) absorbs the heat using the liquid in the ground loop;
   - The compressor, (this is what makes the noise in a fridge) moves the refrigerant round the heat pump and compresses the gaseous refrigerant to the temperature needed for the heat distribution circuit;
   - The condenser, (the hot part at the back of your fridge) gives up heat to a hot water tank which feeds the distribution system.

3. **Heat distribution system**

This consists of under floor heating or radiators for space heating and in some cases water storage for hot water supply.
You should consider the following issues if you're thinking about installing a ground source heat pump. An accredited installer will be able to provide more detailed advice.

- You will need space outside your house for the ground loop.
- The ground will need to be suitable for digging a trench or borehole.
- What fuel is being replaced? If it's electricity, oil, LPG or coal the savings will be more favourable than gas. Heat pumps are a good option where gas is unavailable.
- The type of heat distribution system. Ground source heat pumps can be combined with radiators but these will normally be larger than with standard boiler systems. Under floor heating is better as it works at a lower temperature.
- Want to further reduce your home's carbon dioxide emissions? Install solar PV or some other form of renewable electricity generating system to power the compressor and pump.
- Is the system for a new building development? Combining the installation with other building works can reduce costs.

Air and water source heat pumps

Air and water source heat pumps use air or water respectively. They do not rely on a collection system and simply extract the heat from the source at the point of use.
Air source heat pumps can be fitted outside a house or in the roof space and generally perform better at slightly warmer air temperatures. Water source heat pumps can be used to provide heating in homes near to rivers, streams, lakes and lochs for example.

Costs and savings

A typical 8 - 12kW system costs £6,000 - £12,000 (not including the price of distribution system). This can vary with property and location. When installed in an electrically heated home a ground source heat pump could save as much as £880 a year on heating bills and almost 7 tonnes of carbon dioxide a year. Savings will vary depending on what fuel is being replaced.

Phase 1 - Householder Stream.
At present, grants are available for non-reversible closed loop systems, utilising a borehole or trenches. A grant of up to £1,200 is available for domestic systems. For details of how to apply for grants, and of energy efficiency measures that must be in place before the grant can be accessed, please visit www.lowcarbonbuildings.org.uk.

Phase 2 - Community Stream.
Phase 2 of the LCBP is for the installation of micro generation technologies in public sector buildings (including schools, hospitals, housing associations and local authorities) and charitable bodies. Grants are available for up to 50% for installations with a maximum of £30,000. Phase 2 is administered by the BRE, for further information please visit www.lowcarbonbuildingsphase2.org.uk.

4.8 CHP

Combined heat and power (Chp) and Micro combined heat and power (Micro Chp)
CHP (combined heat and power) earlier CHP units where basically diesel engines converted to run on oil or gas, electricity been the primary output and heat been the secondary.
They have been around for many years, but mainly used in larger buildings like hotels and large blocks of flats etc. For CHP systems to be economically viable they need to run for at least 4,000 hours per year. They are more suitable for leisure centres with swimming pools and hospitals that have a high, year round heat demand or in mixed use developments with suitable heat demands However, new housing or office developments may be able to make use of existing CHP schemes nearby

Fuel types for Chp / Micro Chp

Natural Gas

Micro CHP units are currently being developed for the domestic market by Potterton Baxi, and Powergen (Whispergen) and it shouldn't be long before they become commercially available.
Micro CHP boilers work using similar principle to their older commercial counterparts, an engine produces heat and electricity, the heat is used in the home much like heat from a conventional boiler and the electricity is either used in the home or exported into the national grid.

Typical estimated boiler efficiencies for use with natural gas

100% Gas	78% heat
	12% electricity
	10% waste

Biogas

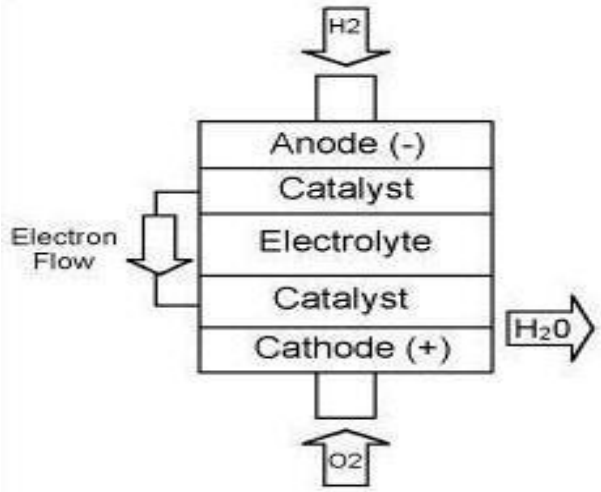
Biogas typically refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen. Biogas originates from biogenic material and is a type of bio fuel. One type of biogas is produced by anaerobic digestion or fermentation of biodegradable materials such as biomass, manure or sewage, municipal waste, and energy crops. This type of biogas comprises primarily methane and carbon dioxide. The other principal type of biogas is wood gas which is created by gasification of wood or other biomass. This type of biogas is comprised primarily of nitrogen, hydrogen, and carbon monoxide, with trace amounts of methane. The gases methane, hydrogen and carbon monoxide can be combusted or oxidized with oxygen. Air contains 21% oxygen. This energy release allows biogas to be used as a fuel. Biogas can be used as a low-cost fuel in any country for any heating purpose, such as cooking. It can also be utilized in modern waste management facilities where it can be used to run any type of heat engine, to generate either mechanical or electrical power. Biogas is a renewable fuel and electricity produced from it can be used to attract renewable energy subsidies in some parts of the world.

Bio Mass

(Please see previous description)

4.9 Fuel Cells

In principle, a fuel cell operates like a battery. Unlike a battery, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied.
A fuel cell consists of two electrodes sandwiched around an electrolyte. Oxygen passes over one electrode and hydrogen over the other, generating electricity, water and heat.
A fuel cell produces electricity.
The fuel cell is similar to a battery. It produces electricity using chemicals. The chemicals are usually very simple, often just hydrogen and oxygen. In this case the hydrogen is the "fuel" that the fuel cell uses to make electricity.
Another very important difference is that fuel cells do not run down like batteries. As long as the fuel and oxygen is supplied to the cell it will keep producing electricity for ever.
The oxygen needed by a fuel cell is usually simply obtained from air.
Although the majority of fuel cells use hydrogen as the fuel, some fuel cells work off methane, and a few use liquid fuels such as methanol.
Fuel cells that use hydrogen can be thought of as devices that do the reverse of the well-known experiment where passing an electric current through water splits it up into hydrogen and oxygen. In the fuel cell hydrogen and oxygen are joined together to produce water and electricity.
Fuel cells can be made in a huge range of sizes. They can be used to produce quite small amounts of electric power, for devices such as portable computers or radio transmitters, right up to very high powers for electric power stations.



Hydrogen fuel is fed into the "anode" of the fuel cell. Oxygen (or air) enters the fuel cell through the cathode. Encouraged by a catalyst, the hydrogen atom splits into a proton and an electron, which take different paths to the cathode. The proton passes through the electrolyte. The electrons create a separate current that can be utilized before they return to the cathode, to be reunited with the hydrogen and oxygen in a molecule of water.
A fuel cell system which includes a "fuel reformer" can utilize the hydrogen from any hydrocarbon fuel - from natural gas to methanol, and even gasoline. Since the fuel cell relies on chemistry and not combustion, emissions from this type of a system would still be much smaller than emissions from the cleanest fuel combustion processes.

FUEL CELLS USING HYDROGEN FROM RENEWABLE SOURCES

Fuel cells can be used as CHP systems in buildings. There are currently several different systems under development using different chemical processes, which operate at different temperatures. They currently use natural gas as the fuel, which is ‘reformed’ to produce hydrogen, the required fuel for the fuel cell. When and if hydrogen becomes available from renewable sources, e.g. as the storage medium of wind generated energy, fuel cell CHP from renewable sources may be possible in buildings.

5 Innovative technologies

The following technologies are not yet classified as LZC technologies; in reality they provide a large reduction in both CO_2 emissions and provide a good end user benefit in terms of energy savings. This list of technologies will expand over the following years, and this section will expand to include any new available innovative technologies.

5.1 Flue Gas Heat Recovery Systems (FGHRS)

The Flue Gas Heat Recovery System is not considered as a low carbon technology although it will be included in a draft consultation by the Energy Saving Trust.
In reality the FGHRS provides a good reduction in CO_2 emissions compared to some technologies that are classified and listed as LZC technologies yet do not provide a reduction in CO_2 emissions when compared to a Natural Gas energy model.

Background

Condensing combination boilers only condense when the flow and return water temperature differential is large enough, generally 11°C, during hot water mode the primary heating water is just circulated around the boiler through a secondary heat exchanger and the temperature differential between flow and return water will be very low and therefore the boiler will not condense.

How it works

The FGHRS is fitted above the boiler and is connected to the boiler flue outlet; the flue is the terminated from the FGHRS as normal.
Cold mains water enters the FGHRS and is pre heated by the waste flue gasses via an air to water heat exchanger, the preheated water is then feed to the inlet cold connection on the boiler therefore reducing the amount of gas required to heat the hot water to a sufficient usable temperature.

Costs and maintenance

FGHRS cost between £500-£650 and according to the manufacture will require none or very little maintenance.

Land use

FGHRS requires no specific land use requirements.

Planning

FGHRS require no additional planning requirements.

5.2 Waste Water Heat Recovery Systems (WWHRS)

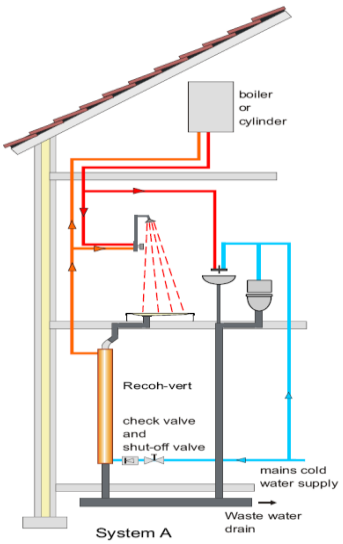


Figure 1

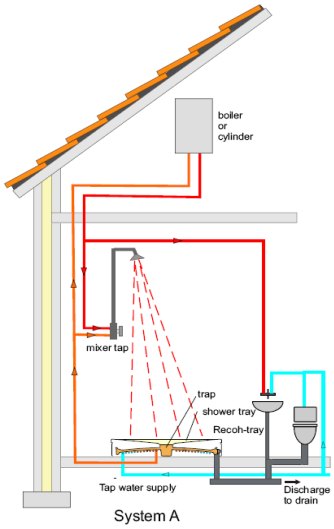


Figure 2

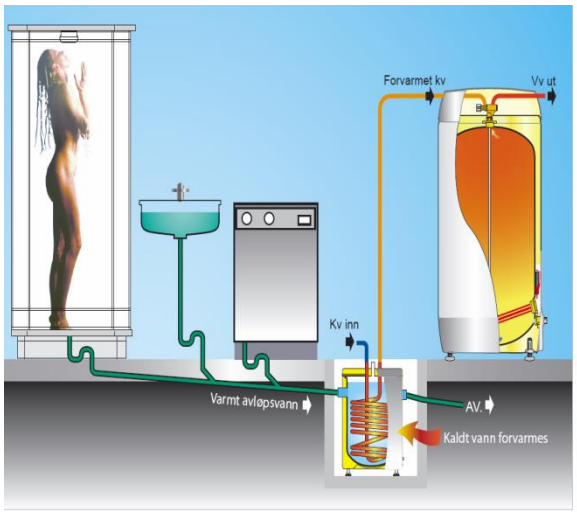


Figure 3

Shower Saver (figure 1 & 2)

Waste Water Heat Recovery Systems (WWHRS) are new to the UK and Appendix Q, following successful experience in The Netherlands where they are fitted to 20% of new dwellings. Although generically classified as a WWHRS the Shower-Save device is primarily applicable to heat recovery from warm shower waste water. Figure 7 shows the most common configuration known as Reco-vert, applicable to upstairs showers, whilst Figure 8 shows the Recoh-tray which can be used in apartments, bungalows or other single storey properties. The principle of heat recovery is the same in both cases:

Warm shower water passes through the 'grey' water side of a copper counter-flow heat exchanger

Mains pressure water simultaneously passes through the fresh water side of the heat exchanger, where it is pre-heated before passing into both the 'cold' inlet of the mixer shower and the 'cold' inlet to the hot water cylinder, combi boiler or other water heater.

The use of pre-heated water (orange line in Figures 1 and 2) reduces the total volume of hot water required per shower, whilst also pre-heating the cold feed to the hot water heater which increases potential flow rates for combi or shortens the re-heat time of cylinders.

The energy saving applies to whichever fuel is used for water heating, which is therefore not limited solely to gas boilers.

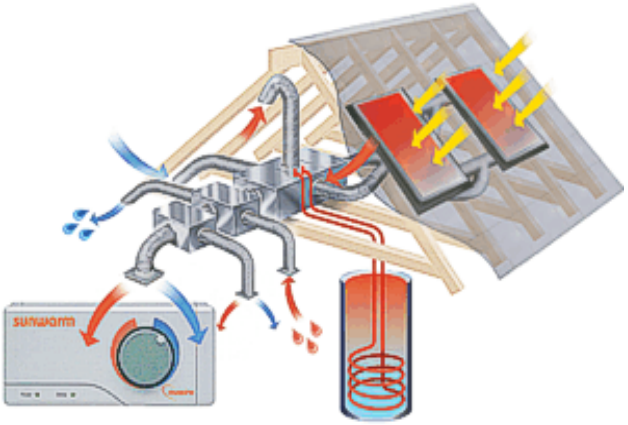
Whilst technically applicable to instantaneous electric showers, these aren't currently modelled by SAP, so it is not possible to apply in Appendix Q either.

Does not save energy from baths, in which hot water use is in advance of grey water disposal, but is applicable to the shower over a bath.

Waste water heat recovery System

Figure 3 depicts a whole house Waste Water Heat Recovery System (WWHRS) which is being developed in the Netherlands and is expected to be available in this country during the next year. It is estimated that the system will provide a reduction in energy consumption of approximately 2500Kw pa or approximately 475 Kg/ CO_2 pa for an average dwelling.

5.3 Sunwarm



The Sunwarm System developed by Nuaire could be classified as a LZC technology and was listed on the DTI clear skies renewable energy grant scheme, the technology has been included in this innovative section subject to confirmation of its exact classification.

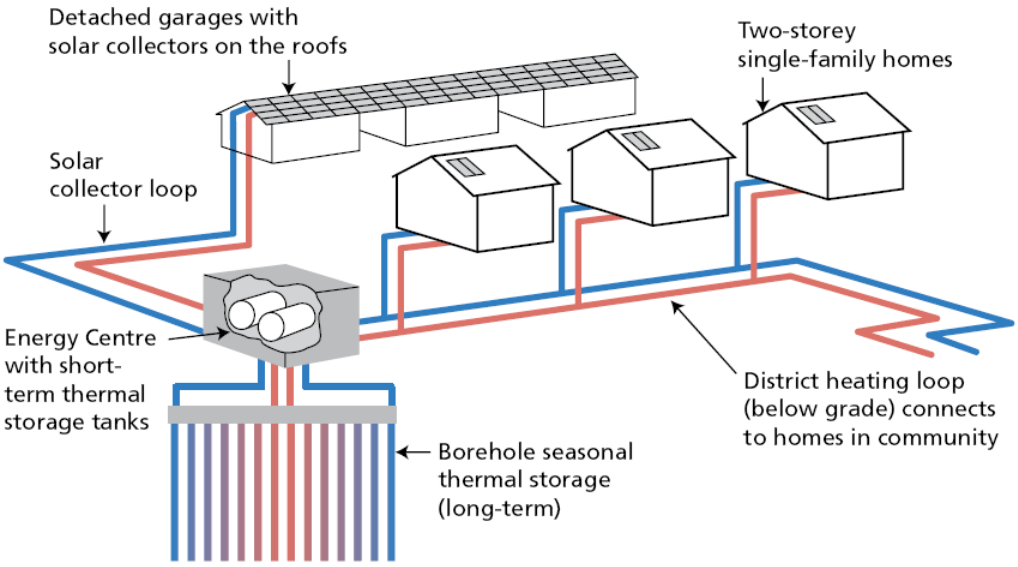
The Sunwarm system is a system that uses solar radiation in the same way Solar thermal uses solar radiation to heat water, the Sunwarm system uses solar radiation to heat air which is then introduced through the ventilation ducting and into the dwelling, the Sunwarm system can also be used to heat water by way of an air to water heat exchanger.

The unit is in the process of being tested by the BRE and will be eventually included in the appendix Q database.

The manufactures claim that the energy saved by the unit as assessed over a winter period will be approximatley1500 Kw and therefore the unit should provide in excess 1500 Kw if assessed over the full year. For the purpose of this feasibility assessment the conservative figure of 1500Kw has been used in the calculation process although this may change when the unit has been entered on the appendix Q database

5.4 Geothermic Storage

Solar Seasonal Storage and District Loop



Geothermic storage systems are and are intended to be used in conjunction with Solar thermal or PV-T systems. The heat produced by both systems can be stored in boreholes in the ground and the heat can then be used throughout the winter period to provide heating through community heating circuits.

The concept was conceived by the Canadian Government and implemented at Drake Landing Okotoks, Alberta, Canada and has successfully integrated the technology and an unlimited solar energy supply feeding 52 homes.

Borehole thermal energy storage allowed water to be heated and collected in large quantities for use in winter, at the end of summer the water was measured to reach temperatures of 80°C and even at the low temperatures associated with the Canadian winters the water temperature at the end of the winter period had been measured at 50°C.

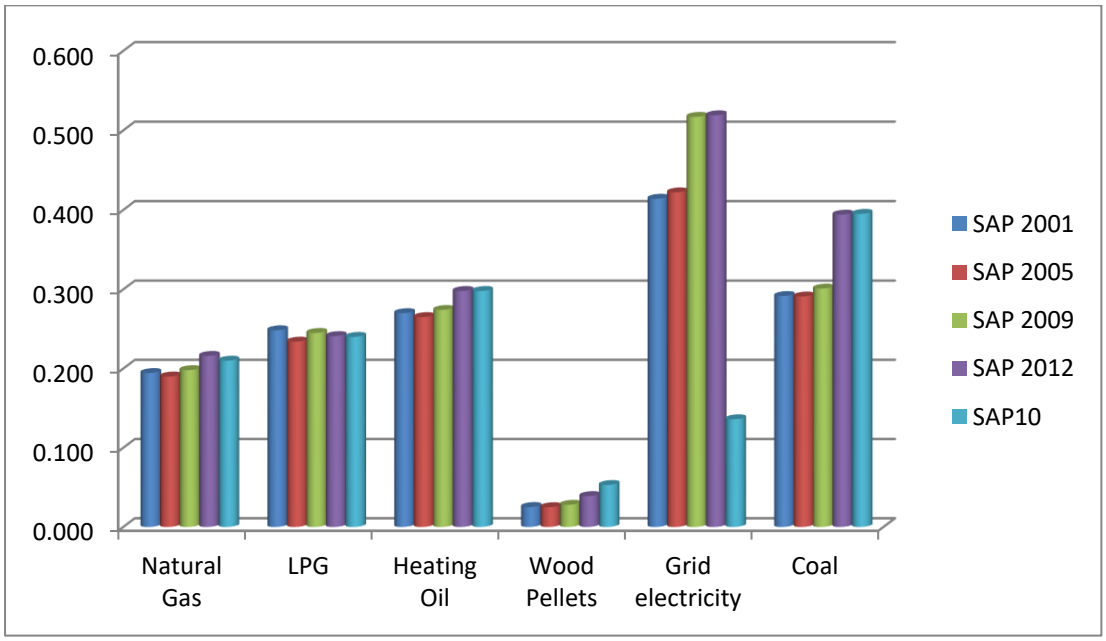
Currently there is no way of assessing the benefit of the Geothermic storage system because of limited test data and therefore the system has not been considered further in this study.

For more information on the Drake landing Solar community please visit www.dlsc.ca

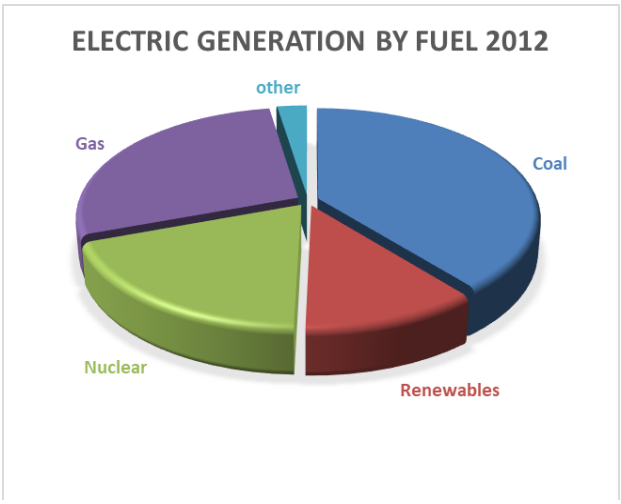
6 Fuel Cost and Carbon

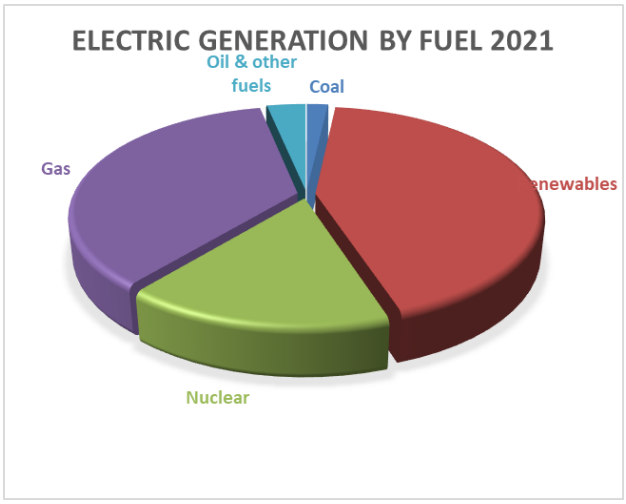
Carbon

Carbon factors including SAP10.1 estimate, due to the decarbonisation of the grid electricity is now the low carbon fuel

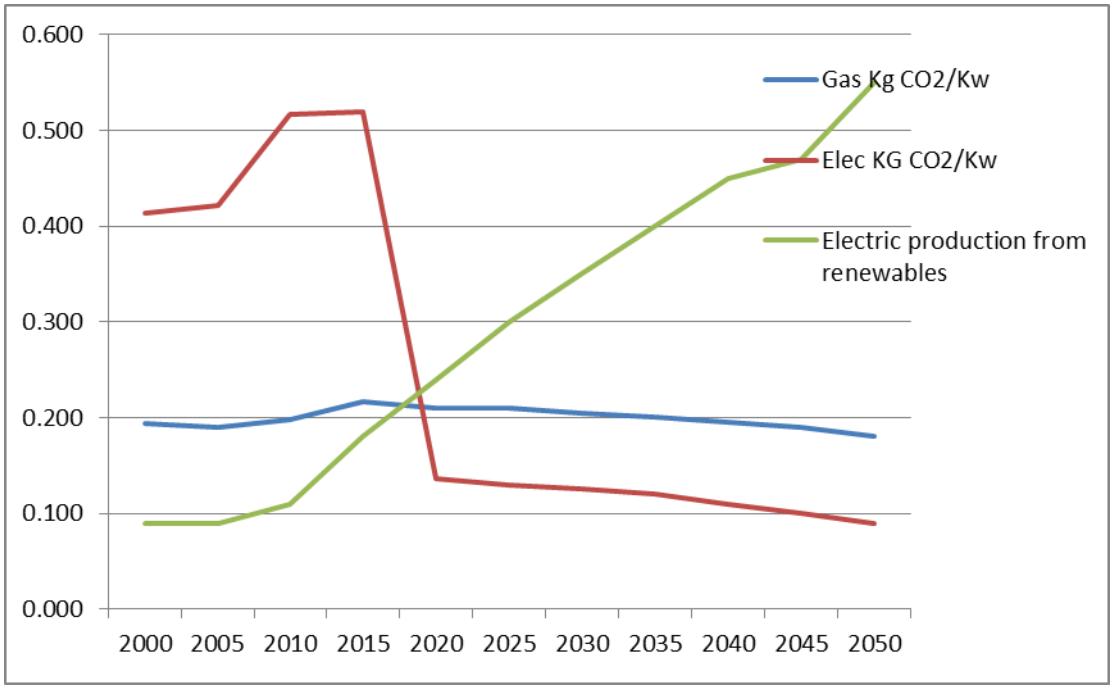


It can be seen that electric generation from renewable technologies has increased as well as a marked reduction in generation from coal however as a consequence the share of electric production from gas has also increased.



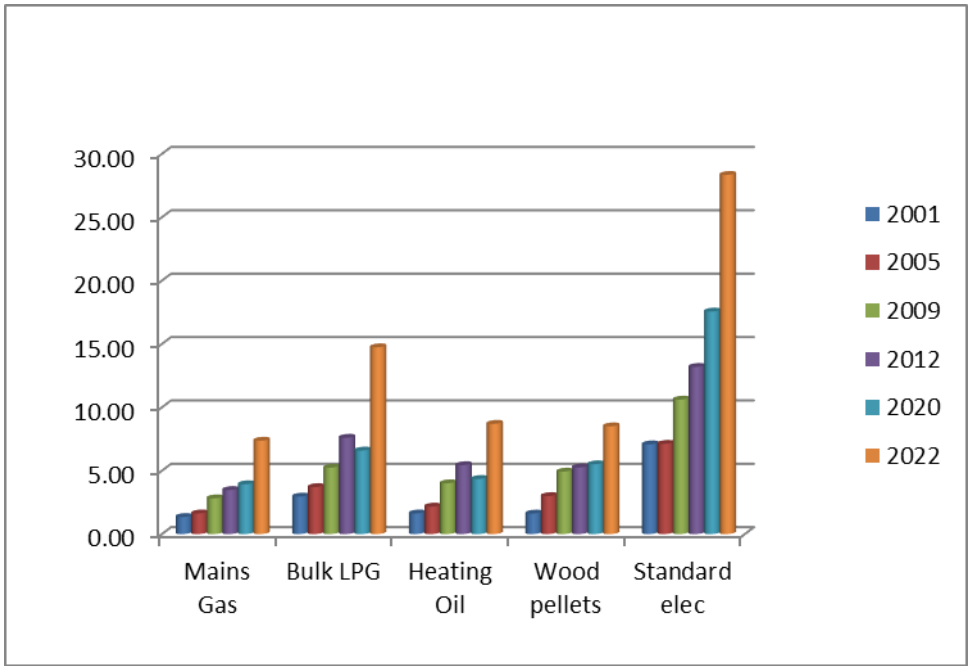


The following graph represents an estimate of CO2 emissions for both gas and electricity and how they may change over the following years; data has been taken from SAP 2001, 2005, 2009, 2012 and SAP10.1 documents.



Running costs

Electricity is the greener fuel although it is also the most expensive fuel, technologies which high efficiencies which further reduce carbon as well as running costs would be preferred.



7 Excluded technology

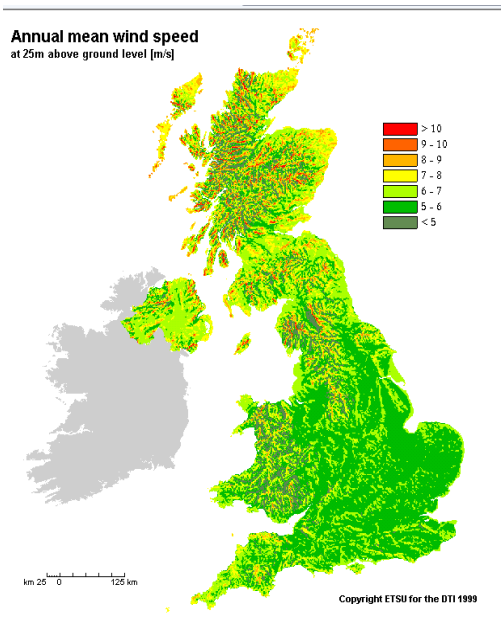
Low or Zero Carbon technologies and other innovative technologies not thought appropriate for use at the proposed development**.**

- Large Mast Wind turbines
- Small scale hydro power
- Solar thermal
- Waste heat from processes such as large scale power generation where the majority of heating comes from waste heat
- Other technologies, Fuel cells using hydrogen from any of the above renewable sources

LZC technology and reasons for their exclusion

Wind turbines

The UK Department of Trade and Industry used to publish a database of average wind speed data for every 1km grid square in the country, known as the NOABL database. The database no longer appears on the DTI website. The data is estimated rather than measured, and takes no account of local features such as walls, buildings, trees and hilltops, which occur at a scale of much less than 1km. These features make a major difference to the wind. To quote the DTI web page: "The data can only be used as a guide and should be followed by on-site measurements for a proper assessment".



In any case, average wind speed is not a reliable predictor of wind turbine output, because the relationship between wind speed and power output is not linear. For example, compare two days: one when the wind blows steadily at 8 mph all day, and another when the wind blows at 16 mph for 12 hours and there is no wind at all for the other 12 hours. Both days have an average wind speed of 8mph, but most turbines would produce more than twice as much power on the second day. One way to approach the problem is to embark on complex statistical calculations involving the 'Rayleigh wind speed distribution'; a simpler method is to carry out a wind survey in the exact spot where the turbine is to be mounted.
The average wind speed for the proposed development is **5 meters per second**, 10 meters above ground level according to the NOABL database; therefore large mast wind turbines may be suitable for use at the proposed site. As previously indicated a detailed an on-site assessment to establish the actual average wind speed would be required to determine the potential suitability of the site for the installation of a large mast wind turbine although it is thought that the land use requirements would be Impractical.

5.2	5	4.6
5	5	4.6
4.6	4.8	4.9

http://www.renew-reuse-recycle.com/noabl.pl?n=503

Small scale hydro power

Small scale hydro would be inappropriate for integration into the proposed development due to the geographical location of the proposed site and its increased proximity to a natural water feature which would be capable of accommodating this type of technology.

Biomass

As well as the increase in running costs and energy use the fuel would need to be delivered to site and there would be a certain degree of organisation required to source the fuel and arrange for delivery which may cause inconvenience on part of the occupier and or housing management team.

Biomass boilers are very efficient and produce very little waste products even so there would be a requirement to remove and dispose of burnt spent fuel frequently.

The Clean Air Acts of 1956 and 1968 were introduced to deal with the smog's of the 1950s and 1960s which were caused by the widespread burning of coal for domestic heating and by industry. This smog's were blamed for the premature deaths of hundreds of people in the UK. The Acts gave local authorities powers to control emissions of dark smoke, grit, dust and fumes from industrial premises and furnaces and to declare "smoke control areas" in which emissions of smoke from domestic properties are banned. Since then, smoke control areas have been introduced in many of our large towns and cities in the UK and in large parts of the Midlands, North West, South Yorkshire, North East of England, Central and Southern Scotland. The implementation of smoke control areas, the increased popularity of clean natural gas and the changes in the industrial and economic structure of the UK lead to a substantial reduction in concentrations of smoke and associated levels of sulphur dioxide (SO2) between the 1950s and the present day.

Pollutants associated with biomass combustion include particulate matter (PM_{10}/$PM_{2.5}$) and nitrogen oxides (NO_x) emissions. These pollution emissions can have an impact on local air quality and affect human health, a report provided by DEFRA concluded that the negative effects on air quality associated with biomass primary installations especially in urban developments could out way any benefit associated with CO_2 reduction.

A permit would be required which would need to be purchased from the local authority and the local authority could refuse or revoke licence at any time in the future.

It is considered that Bio Mass would not be suitable for integration at the proposed development for these reasons.

From wasted heat

Community heating including utilising waste heat from processes such as large scale power generation or industrial heat generation where the majority of heating comes from waste heat would be inappropriate for integration at the proposed development due to the geographical location of the proposed site and its increased proximity to an industrial heating or power generation source that would be capable of supporting this type of technology.

Specific details relating to the new commercial / retail element of the scheme is so far unknown, energy from wasted heat from use of these building may be able to contribute towards the heat requirements of residential units and this should be considered in greater detail one this information becomes available.

Other technologies

Fuel cell etc, not yet fully commercially available.

8 Suitable technologies

The following Low or Zero carbon technologies and innovative technologies are to be considered in more detail for integration at the proposed development.

- Solar Photovoltaic
- Air Source or Ground Source Heat Pump (ASHP & GSHP)

High efficiency technologies such as Ground and Air Source Heat pumps will have the largest effect on Carbon reduction and Primary Energy reduction.

Microgeneration technologies including Photovoltaic technology if coupled with battery storage will have the largest benefit in reducing occupiers running costs and reducing Primary Energy.

Heat Pump Technologies and Solar Photovoltaic technologies are both considered suitable for integration at the proposed development.

9 Appendix A – SAP calculations

- HT736
- HT847
- HT889
- HT980
- HT1280

Full SAP Calculation Printout

Property Reference	HL0736A-Semi	**Issued on Date**	16/11/2023
Assessment Reference	001	**Prop Type Ref**	HT-HL736A (Semi)
Property	S63 0JF		

SAP Rating	92 A	**DER**	11.69	**TER**	12.34
Environmental	91 B	**% DER < TER**			5.27
CO_2 Emissions (t/year)	0.79	**DFEE**	35.99	**TFEE**	37.08
Compliance Check	See BREL	**% DFEE < TFEE**			2.95
% DPER < TPER	4.08	**DPER**	61.93	**TPER**	64.57

Assessor Details	Mr. Paul Goddard	**Assessor ID**	B342-0001
Client	Hoober Homes, Hoober Homes		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	36.2300 (1b)	x	2.3100 (2b)	=	83.6913	(1b) - (3b)
First floor	36.2300 (1c)	x	2.6800 (2c)	=	97.0964	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	180.7877	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			12.4600	1.1450	14.2672			(27)
GF			36.2300	0.1100	3.9853	75.0000	2717.2500	(28a)
Main	84.9797	14.6100	70.3697	0.1800	12.6665	110.0000	7740.6669	(29a)
PIJ	36.2300		36.2300	0.1000	3.6230	9.0000	326.0700	(30)
Total net area of external elements Aum(A, m2)			157.4397					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.6920			(33)
Party Wall 1			41.1200	0.0000	0.0000	70.0000	2878.4000	(32)
Internal Wall 1			113.1200			9.0000	1018.0800	(32c)
Internal Floor 1			36.2300			18.0000	652.1400	(32d)
Internal Ceiling 1			36.2300			9.0000	326.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15658.6769 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		216.1010 (35)
List of Thermal Bridges		

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	9.8500	0.0500	0.4925	
E3 Sill	9.8500	0.0200	0.1970	
E4 Jamb	17.4000	0.0160	0.2784	
E5 Ground floor (normal)	17.0300	0.1000	1.7030	
E6 Intermediate floor within a dwelling	17.0300	0.0000	0.0000	
E16 Corner (normal)	9.9800	0.0510	0.5090	
E18 Party wall between dwellings	9.9800	0.0290	0.2894	
P1 Party wall - Ground floor	8.2400	0.0800	0.6592	
E10 Eaves (insulation at ceiling level)	8.7900	0.1220	1.0724	
E12 Gable (insulation at ceiling level)	8.2400	0.0770	0.6345	
P4 Party wall - Roof (insulation at ceiling level)	8.2400	0.0410	0.3378	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			6.1732	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	42.8652	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	31.0791	30.7622	30.4452	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	(38)
Heat transfer coeff	73.9443	73.6274	73.3104	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	(39)
Average = Sum(39)m / 12 =												72.9282	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0205	1.0161	1.0117	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	(40)
HLP (average)												1.0065	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3043	(42)
Hot water usage for mixer showers	62.8558	61.9112	60.5347	57.9011	55.9576	53.7901	52.5582	53.9242	55.4217	57.7488	60.4390	62.6150	(42a)
Hot water usage for baths	27.1533	26.7500	26.1821	25.1351	24.3510	23.4817	23.0121	23.5760	24.1900	25.1202	26.1889	27.0615	(42b)
Hot water usage for other uses	38.2287	36.8386	35.4484	34.0583	32.6682	31.2780	31.2780	32.6682	34.0583	35.4484	36.8386	38.2287	(42c)
Average daily hot water use (litres/day)												117.8797	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	128.2378	125.4998	122.1653	117.0945	112.9768	108.5498	106.8483	110.1684	113.6699	118.3175	123.4664	127.9052	(44)
Energy conte	203.0973	178.7100	187.7635	160.2965	152.0884	133.4747	129.2237	136.4114	140.1664	160.5557	175.9006	200.2686	(45)
Energy content (annual)										Total = Sum(45)m =		1957.9568	
Distribution loss (46)m = 0.15 x (45)m	30.4646	26.8065	28.1645	24.0445	22.8133	20.0212	19.3836	20.4617	21.0250	24.0834	26.3851	30.0403	(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	14.8262	13.3772	14.7802	14.2392	14.6732	14.1587	14.6046	14.6261	14.1788	14.6986	14.2860	14.8177	(61)
Total heat required for water heating calculated for each month	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(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	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
										Total per year (kWh/year) = Sum(64)m =		2131.2233	(64)
12Total per year (kWh/year)												2131	(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	71.2364	62.7654	66.1264	56.8584	54.2377	47.9200	46.6180	49.0133	50.1500	57.0594	62.0584	70.2937	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	105.3698	116.6595	105.3698	108.8822	105.3698	108.8822	105.3698	105.3698	108.8822	105.3698	108.8822	105.3698	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	202.9691	205.0753	199.7678	188.4687	174.2056	160.8004	151.8448	149.7387	155.0462	166.3453	180.6083	194.0136	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	(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)	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	(71)
Water heating gains (Table 5)	95.7479	93.4009	88.8796	78.9700	72.9001	66.5556	62.6586	65.8781	69.6528	76.6928	86.1923	94.4808	(72)
Total internal gains	464.6518	475.7006	454.5822	436.8859	413.0406	393.8032	377.4384	378.5517	391.1462	408.9729	436.2478	454.4292	(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	
East	4.3300	19.6403	0.3000	0.0000	0.7700	19.6448	(76)
South	0.6000	46.7521	0.3000	0.0000	0.7700	6.4798	(78)
West	7.5300	19.6403	0.3000	0.0000	0.7700	34.1629	(80)

Solar gains	60.2875	115.8715	186.8650	268.0945	325.7567	332.4938	316.9310	273.9180	215.7309	136.3452	74.7726	49.8480	(83)
Total gains	524.9393	591.5721	641.4473	704.9804	738.7973	726.2969	694.3693	652.4697	606.8771	545.3181	511.0204	504.2772	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.8231	59.0763	59.3317	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	
alpha	4.9215	4.9384	4.9554	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	
util living area	0.9914	0.9836	0.9659	0.9104	0.7940	0.6138	0.4554	0.5034	0.7451	0.9364	0.9832	0.9928	(86)
MIT	19.7840	19.9718	20.2439	20.5938	20.8472	20.9667	20.9938	20.9899	20.9156	20.5808	20.1322	19.7691	(87)
Th 2	20.0663	20.0699	20.0736	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	(88)
util rest of house	0.9891	0.9791	0.9565	0.8863	0.7439	0.5358	0.3629	0.4072	0.6719	0.9139	0.9779	0.9909	(89)
MIT 2	18.9657	19.1539	19.4230	19.7596	19.9788	20.0648	20.0788	20.0775	20.0345	19.7547	19.3224	18.9622	(90)
Living area fraction									fLA = Living area / (4) =			0.2099	(91)
MIT	19.1375	19.3256	19.5953	19.9347	20.1611	20.2541	20.2709	20.2690	20.2194	19.9281	19.4924	19.1316	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9875	19.1756	19.4453	19.7847	20.0111	20.1041	20.1209	20.1190	20.0694	19.7781	19.3424	18.9816	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9735	0.9485	0.8772	0.7398	0.5379	0.3670	0.4113	0.6709	0.9048	0.9723	0.9877	(94)
Useful gains	517.2610	575.9246	608.3983	618.4099	546.5428	390.6802	254.8372	268.3896	407.1527	493.3897	496.8432	498.0673	(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	1086.0581	1051.0763	949.0245	791.2629	604.1761	400.1252	255.9520	270.3524	433.9487	667.2029	889.9636	1074.5491	(97)
Space heating kWh	423.1851	319.3020	253.4259	124.4541	42.8792	0.0000	0.0000	0.0000	0.0000	129.3170	283.0467	428.9024	(98a)
Space heating requirement - total per year (kWh/year)												2004.5125	
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	423.1851	319.3020	253.4259	124.4541	42.8792	0.0000	0.0000	0.0000	129.3170	283.0467	428.9024	(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												2004.5125	
Space heating per m2										(98c) / (4) =		27.6637	(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 %) 89.0000 (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	423.1851	319.3020	253.4259	124.4541	42.8792	0.0000	0.0000	0.0000	0.0000	129.3170	283.0467	428.9024	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	475.4889	358.7662	284.7482	139.8361	48.1789	0.0000	0.0000	0.0000	0.0000	145.3000	318.0300	481.9128	(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	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4148	88.3537	88.2367	87.9997	87.6424	87.3000	87.3000	87.3000	87.3000	88.0138	88.3089	88.4249	(217)
Fuel for water heating, kWh/month	246.4786	217.4070	229.5458	198.3367	190.2750	169.1104	164.7518	173.0098	176.7986	199.1214	215.3651	243.2418	(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	10.3104	9.3126	10.3104	9.9778	10.3104	9.9778	10.3104	10.3104	9.9778	10.3104	9.9778	10.3104	(231)
Lighting	25.3000	20.2966	18.2748	13.3889	10.3420	8.4495	9.4343	12.2631	15.9285	20.8991	23.6055	26.0032	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.2993	-35.1951	-56.9483	-70.1424	-79.3512	-75.2840	-74.0462	-67.8306	-56.8088	-42.6542	-25.5513	-18.6886	(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	-8.8988	-21.7746	-52.0352	-91.4879	-132.5438	-137.7289	-134.1948	-106.2115	-68.3918	-33.5287	-12.4485	-6.7337	(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 2252.2612 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 87.3000

Water heating fuel used 2423.4421 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

(MEVDecentralised, Database: total watage = 4.6540, total flow = 29.0000, SFP = 0.1605)

mechanical ventilation fans (SFP = 0.1605) 35.3962 (230a)

central heating pump 41.0000 (230c)

main heating flue fan 45.0000 (230e)

Total electricity for the above, kWh/year	121.3962	(231)
Electricity for lighting (calculated in Appendix L)	204.1855	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1430.7783	(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	3570.5068	(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	2252.2612	0.2100	472.9749	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2423.4421	0.2100	508.9228	(264)
Space and water heating			981.8977	(265)
Pumps, fans and electric keep-hot	121.3962	0.1387	16.8392	(267)
Energy for lighting	204.1855	0.1443	29.4703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-624.8000	0.1328	-82.9702	
PV Unit electricity exported	-805.9783	0.1222	-98.4866	
Total			-181.4567	(269)
Total CO2, kg/year			846.7504	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.6900	(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	2252.2612	1.1300	2545.0552	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2423.4421	1.1300	2738.4895	(278)
Space and water heating			5283.5447	(279)
Pumps, fans and electric keep-hot	121.3962	1.5128	183.6482	(281)
Energy for lighting	204.1855	1.5338	313.1865	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-624.8000	1.4907	-931.3846	
PV Unit electricity exported	-805.9783	0.4484	-361.3689	
Total			-1292.7535	(283)
Total Primary energy kWh/year			4487.6260	(286)
Dwelling Primary energy Rate (DPER)			61.9300	(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		36.2300 (1b)	x	2.3100 (2b)	=	83.6913	(1b) - (3b)
First floor		36.2300 (1c)	x	2.6800 (2c)	=	97.0964	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.4600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	180.7877	(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)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1659	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4159	(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) =	0.3535	(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													
	0.4508	0.4419	0.4331	0.3889	0.3801	0.3359	0.3359	0.3270	0.3535	0.3801	0.3977	0.4154	(22b)
Effective ac	0.6016	0.5977	0.5938	0.5756	0.5722	0.5564	0.5564	0.5535	0.5625	0.5722	0.5791	0.5863	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.20)			12.4600	1.1450	14.2672			(27)
GF			36.2300	0.1300	4.7099			(28a)
Main	84.9797	14.6100	70.3697	0.1800	12.6665			(29a)
PIJ	36.2300		36.2300	0.1100	3.9853			(30)
Total net area of external elements Aum(A, m2)			157.4397					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.7789			(33)
Party Wall 1			41.1200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 216.1010 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.8500	0.0500	0.4925
E3 Sill	9.8500	0.0500	0.4925
E4 Jamb	17.4000	0.0500	0.8700
E5 Ground floor (normal)	17.0300	0.1600	2.7248
E6 Intermediate floor within a dwelling	17.0300	0.0000	0.0000
E16 Corner (normal)	9.9800	0.0900	0.8982
E18 Party wall between dwellings	9.9800	0.0600	0.5988
P1 Party wall - Ground floor	8.2400	0.0800	0.6592
E10 Eaves (insulation at ceiling level)	8.7900	0.0600	0.5274
E12 Gable (insulation at ceiling level)	8.2400	0.0600	0.4944
P4 Party wall - Roof (insulation at ceiling level)	8.2400	0.1200	0.9888

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.7466 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 46.5255 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.8914	35.6560	35.4253	34.3417	34.1389	33.1951	33.1951	33.0203	33.5586	34.1389	34.5491	34.9779	(38)
Heat transfer coeff	82.4169	82.1815	81.9508	80.8672	80.6644	79.7206	79.7206	79.5458	80.0842	80.6644	81.0746	81.5034	(39)
Average = Sum(39)m / 12 =												80.8662	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1374	1.1342	1.1310	1.1160	1.1132	1.1002	1.1002	1.0978	1.1052	1.1132	1.1189	1.1248	(40)
HLP (average)												1.1160	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3043 (42)

Hot water usage for mixer showers													
	62.8558	61.9112	60.5347	57.9011	55.9576	53.7901	52.5582	53.9242	55.4217	57.7488	60.4390	62.6150	(42a)
Hot water usage for baths													
	27.1533	26.7500	26.1821	25.1351	24.3510	23.4817	23.0121	23.5760	24.1900	25.1202	26.1889	27.0615	(42b)
Hot water usage for other uses													
	38.2287	36.8386	35.4484	34.0583	32.6682	31.2780	31.2780	32.6682	34.0583	35.4484	36.8386	38.2287	(42c)
Average daily hot water use (litres/day)												117.8797	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	128.2378	125.4998	122.1653	117.0945	112.9768	108.5498	106.8483	110.1684	113.6699	118.3175	123.4664	127.9052	(44)
Energy conte	203.0973	178.7100	187.7635	160.2965	152.0884	133.4747	129.2237	136.4114	140.1664	160.5557	175.9006	200.2686	(45)
Energy content (annual)										Total = Sum(45)m =		1957.9568	
Distribution loss (46)m = 0.15 x (45)m													
	30.4646	26.8065	28.1645	24.0445	22.8133	20.0212	19.3836	20.4617	21.0250	24.0834	26.3851	30.0403	(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													
	254.0562	224.7374	238.7224	209.6115	203.0473	182.7897	180.1826	187.3703	189.4815	211.5146	225.2156	251.2275	(62)
WWHRS	-28.7350	-25.4135	-26.6116	-22.0354	-20.5362	-17.5730	-16.4719	-17.5162	-18.1817	-21.4342	-24.2824	-28.2029	(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													
	225.3212	199.3239	212.1109	187.5761	182.5111	165.2167	163.7107	169.8542	171.2998	190.0804	200.9333	223.0246	(64)
										Total per year (kWh/year) = Sum(64)m =		2290.9628	(64)
12Total per year (kWh/year)												2291	(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													
	80.2696	70.9279	75.1711	65.6273	63.3091	56.7091	55.7066	58.0965	58.9341	66.1245	70.8157	79.3290	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	105.3698	116.6595	105.3698	108.8822	105.3698	108.8822	105.3698	105.3698	108.8822	105.3698	108.8822	105.3698	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	202.9691	205.0753	199.7678	188.4687	174.2056	160.8004	151.8448	149.7387	155.0462	166.3453	180.6083	194.0136	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	(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)													

	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	(71)
Water heating gains (Table 5)													
	107.8892	105.5475	101.0364	91.1491	85.0929	78.7626	74.8745	78.0867	81.8529	88.8770	98.3552	106.6250	(72)
Total internal gains													
	476.7932	487.8473	466.7391	449.0650	425.2334	406.0102	389.6542	390.7603	403.3463	421.1571	448.4107	466.5735	(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	
East	4.3300	19.6403	0.6300	0.7000	0.7700	25.9900	(76)
South	0.6000	46.7521	0.6300	0.7000	0.7700	8.5728	(78)
West	7.5300	19.6403	0.6300	0.7000	0.7700	45.1975	(80)

Solar gains	79.7603	153.2980	247.2225	354.6891	430.9761	439.8892	419.2997	362.3935	285.4120	180.3847	98.9242	65.9489	(83)
Total gains	556.5535	641.1452	713.9615	803.7541	856.2095	845.8995	808.9539	753.1538	688.7583	601.5419	547.3348	532.5223	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.7760	52.9271	53.0761	53.7874	53.9226	54.5610	54.5610	54.6808	54.3133	53.9226	53.6498	53.3675	
alpha	4.5184	4.5285	4.5384	4.5858	4.5948	4.6374	4.6374	4.6454	4.6209	4.5948	4.5767	4.5578	
util living area													
	0.9900	0.9803	0.9580	0.8913	0.7631	0.5788	0.4285	0.4770	0.7216	0.9273	0.9808	0.9917	(86)
MIT	19.6288	19.8453	20.1610	20.5627	20.8384	20.9655	20.9930	20.9888	20.9070	20.5307	20.0159	19.5990	(87)
Th 2	19.9704	19.9730	19.9756	19.9878	19.9900	20.0007	20.0007	20.0026	19.9966	19.9900	19.9854	19.9806	(88)
util rest of house													
	0.9872	0.9749	0.9464	0.8628	0.7077	0.4978	0.3337	0.3778	0.6428	0.9015	0.9746	0.9894	(89)
MIT 2	18.3885	18.6640	19.0606	19.5527	19.8555	19.9804	19.9982	19.9983	19.9333	19.5291	18.8914	18.3578	(90)
Living area fraction									fLA = Living area / (4) =			0.2099	(91)
MIT	18.6488	18.9119	19.2916	19.7647	20.0618	20.1872	20.2070	20.2062	20.1377	19.7393	19.1275	18.6183	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6488	18.9119	19.2916	19.7647	20.0618	20.1872	20.2070	20.2062	20.1377	19.7393	19.1275	18.6183	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9675	0.9366	0.8555	0.7119	0.5135	0.3536	0.3985	0.6548	0.8936	0.9675	0.9850	(94)
Useful gains	546.6196	620.2855	668.7295	687.5953	609.5712	434.3449	286.0211	300.1290	450.9748	537.5521	529.5411	524.5276	(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													
	1182.5861	1151.5217	1048.2830	878.5987	674.5028	445.4137	287.5561	302.7705	483.5239	737.2189	975.1230	1175.1439	(97)
Space heating kWh													
	473.1590	356.9908	282.3878	137.5224	48.3091	0.0000	0.0000	0.0000	0.0000	148.5521	320.8190	484.0585	(98a)
Space heating requirement - total per year (kWh/year)												2251.7988	
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													
	473.1590	356.9908	282.3878	137.5224	48.3091	0.0000	0.0000	0.0000	0.0000	148.5521	320.8190	484.0585	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2251.7988	
Space heating per m2											(98c) / (4) =	31.0764	(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													
	473.1590	356.9908	282.3878	137.5224	48.3091	0.0000	0.0000	0.0000	0.0000	148.5521	320.8190	484.0585	(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)													
	512.0769	386.3537	305.6145	148.8338	52.2826	0.0000	0.0000	0.0000	0.0000	160.7707	347.2067	523.8729	(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													
	225.3212	199.3239	212.1109	187.5761	182.5111	165.2167	163.7107	169.8542	171.2998	190.0804	200.9333	223.0246	(64)
Efficiency of water heater												80.3000	(216)
(217)m	85.9312	85.6147	84.9954	83.7262	81.9594	80.3000	80.3000	80.3000	80.3000	83.8587	85.3786	85.9951	(217)
Fuel for water heating, kWh/month													
	262.2111	232.8149	249.5557	224.0351	222.6848	205.7494	203.8739	211.5245	213.3247	226.6674	235.3439	259.3458	(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	21.8938	17.5640	15.8144	11.5863	8.9496	7.3119	8.1641	10.6121	13.7840	18.0854	20.4274	22.5023	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-33.9698	-47.9284	-68.9529	-77.6087	-83.7674	-78.2290	-77.2706	-72.9108	-65.2228	-54.8479	-37.3623	-29.3652	(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	-19.0781	-40.1483	-79.8216	-119.9183	-158.5876	-159.3431	-157.4595	-133.3024	-97.6885	-57.4171	-25.4735	-15.0847	(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	2437.0116	(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	2747.1312	(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)	176.6953	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1790.7585	(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	3656.0796	(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	2437.0116	0.2100	511.7724	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2747.1312	0.2100	576.8976	(264)
Space and water heating			1088.6700	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	176.6953	0.1443	25.5026	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-727.4359	0.1346	-97.8860	
PV Unit electricity exported	-1063.3226	0.1259	-133.8613	
Total			-231.7473	(269)
Total CO2, kg/year			894.3545	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.3400	(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	2437.0116	1.1300	2753.8232	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2747.1312	1.1300	3104.2583	(278)
Space and water heating			5858.0814	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	176.6953	1.5338	271.0211	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-727.4359	1.4973	-1089.2051	
PV Unit electricity exported	-1063.3226	0.4621	-491.3630	
Total			-1580.5681	(283)
Total Primary energy kWh/year			4678.6352	(286)
Target Primary Energy Rate (TPER)			64.5700	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		36.2300 (1b)	x	2.3100 (2b)	=	83.6913	(1b) - (3b)
First floor		36.2300 (1c)	x	2.6800 (2c)	=	97.0964	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.4600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	180.7877	(5)

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2. Ventilation rate

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		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)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1659 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4159 (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) =	0.3535 (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	0.4508	0.4419	0.4331	0.3889	0.3801	0.3359	0.3359	0.3270	0.3535	0.3801	0.3977	0.4154	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.6016	0.5977	0.5938	0.5756	0.5722	0.5564	0.5564	0.5535	0.5625	0.5722	0.5791	0.5863	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			12.4600	1.1450	14.2672			(27)
GF			36.2300	0.1100	3.9853	75.0000	2717.2500	(28a)
Main	84.9797	14.6100	70.3697	0.1800	12.6665	110.0000	7740.6669	(29a)
PIJ	36.2300		36.2300	0.1000	3.6230	9.0000	326.0700	(30)
Total net area of external elements Aum(A, m2)			157.4397					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.6920			(33)
Party Wall 1			41.1200	0.0000	0.0000	70.0000	2878.4000	(32)
Internal Wall 1			113.1200			9.0000	1018.0800	(32c)
Internal Floor 1			36.2300			18.0000	652.1400	(32d)
Internal Ceiling 1			36.2300			9.0000	326.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15658.6769 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		216.1010 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.8500	0.0500	0.4925
E3 Sill	9.8500	0.0200	0.1970
E4 Jamb	17.4000	0.0160	0.2784
E5 Ground floor (normal)	17.0300	0.1000	1.7030
E6 Intermediate floor within a dwelling	17.0300	0.0000	0.0000
E16 Corner (normal)	9.9800	0.0510	0.5090
E18 Party wall between dwellings	9.9800	0.0290	0.2894
P1 Party wall - Ground floor	8.2400	0.0800	0.6592
E10 Eaves (insulation at ceiling level)	8.7900	0.1220	1.0724
E12 Gable (insulation at ceiling level)	8.2400	0.0770	0.6345
P4 Party wall - Roof (insulation at ceiling level)	8.2400	0.0410	0.3378

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.1732 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	42.8652 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.8914	35.6560	35.4253	34.3417	34.1389	33.1951	33.1951	33.0203	33.5586	34.1389	34.5491	34.9779	(38)
Heat transfer coeff	78.7566	78.5212	78.2905	77.2069	77.0041	76.0603	76.0603	75.8855	76.4239	77.0041	77.4143	77.8431	(39)
Average = Sum(39)m / 12 =												77.2059	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0869	1.0836	1.0805	1.0655	1.0627	1.0497	1.0497	1.0473	1.0547	1.0627	1.0684	1.0743	(40)
HLP (average)												1.0655	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3043 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

27.1533	26.7500	26.1821	25.1351	24.3510	23.4817	23.0121	23.5760	24.1900	25.1202	26.1889	27.0615	(42b)

Hot water usage for other uses

38.2287	36.8386	35.4484	34.0583	32.6682	31.2780	31.2780	32.6682	34.0583	35.4484	36.8386	38.2287	(42c)

Average daily hot water use (litres/day)		59.9287 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	65.3820	63.5886	61.6306	59.1934	57.0192	54.7597	54.2901	56.2441	58.2483	60.5687	63.0274	65.2902	(44)
Energy conte	103.5491	90.5493	94.7239	81.0328	76.7588	67.3334	65.6592	69.6420	71.8259	82.1911	89.7941	102.2286	(45)
Energy content (annual)										Total = Sum(45)m =		995.2882	
Distribution loss (46)m = 0.15 x (45)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	(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	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	88.0167	76.9669	80.5153	68.8778	65.2450	57.2334	55.8103	59.1957	61.0521	69.8624	76.3250	86.8944	(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

	88.0167	76.9669	80.5153	68.8778	65.2450	57.2334	55.8103	59.1957	61.0521	69.8624	76.3250	86.8944	(64)
										Total per year (kWh/year) = Sum(64)m =		845.9950	(64)
12Total per year (kWh/year)												846	(64)
Electric shower(s)													
	50.3370	44.8507	48.9752	46.7365	47.6135	45.4186	46.9326	47.6135	46.7365	48.9752	48.0543	50.3370	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		572.5807	(64a)
Heat gains from water heating, kWh/month													
	34.5884	30.4544	32.3726	28.9036	28.2146	25.6630	25.6857	26.7023	26.9471	29.7094	31.0948	34.3078	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	105.3698	116.6595	105.3698	108.8822	105.3698	108.8822	105.3698	105.3698	108.8822	105.3698	108.8822	105.3698	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	202.9691	205.0753	199.7678	188.4687	174.2056	160.8004	151.8448	149.7387	155.0462	166.3453	180.6083	194.0136	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	(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)													
	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	(71)
Water heating gains (Table 5)													
	46.4898	45.3190	43.5116	40.1439	37.9229	35.6431	34.5238	35.8902	37.4266	39.9320	43.1873	46.1127	(72)
Total internal gains													
	412.3938	424.6188	406.2142	395.0597	375.0634	362.8907	349.3035	348.5637	358.9200	369.2121	390.2428	403.0611	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.3000	0.0000	0.7700	19.6448	(76)
South	0.6000	46.7521	0.3000	0.0000	0.7700	6.4798	(78)
West	7.5300	19.6403	0.3000	0.0000	0.7700	34.1629	(80)

Solar gains	60.2875	115.8715	186.8650	268.0945	325.7567	332.4938	316.9310	273.9180	215.7309	136.3452	74.7726	49.8480	(83)
Total gains	472.6813	540.4903	593.0793	663.1543	700.8201	695.3844	666.2345	622.4817	574.6509	505.5574	465.0154	452.9091	(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	55.2288	55.3944	55.5576	56.3374	56.4857	57.1866	57.1866	57.3183	56.9146	56.4857	56.1864	55.8769	
alpha	4.6819	4.6930	4.7038	4.7558	4.7657	4.8124	4.8124	4.8212	4.7943	4.7657	4.7458	4.7251	
util living area													
	0.9947	0.9893	0.9769	0.9340	0.8354	0.6569	0.4931	0.5451	0.7900	0.9557	0.9893	0.9956	(86)
MIT	19.5814	19.7746	20.0657	20.4691	20.7795	20.9492	20.9896	20.9835	20.8761	20.4641	19.9620	19.5579	(87)
Th 2	20.0115	20.0142	20.0168	20.0291	20.0314	20.0421	20.0421	20.0441	20.0380	20.0314	20.0267	20.0219	(88)
util rest of house													
	0.9931	0.9863	0.9700	0.9141	0.7881	0.5744	0.3903	0.4393	0.7179	0.9383	0.9857	0.9944	(89)
MIT 2	18.7224	18.9161	19.2051	19.6024	19.8809	20.0176	20.0391	20.0389	19.9682	19.6064	19.1129	18.7070	(90)
Living area fraction										fLA = Living area / (4) =		0.2099	(91)
MIT	18.9028	19.0963	19.3857	19.7843	20.0695	20.2131	20.2386	20.2372	20.1588	19.7865	19.2911	18.8856	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9028	19.0963	19.3857	19.7843	20.0695	20.2131	20.2386	20.2372	20.1588	19.7865	19.2911	18.8856	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9908	0.9825	0.9644	0.9081	0.7902	0.5899	0.4118	0.4613	0.7279	0.9328	0.9821	0.9924	(94)
Useful gains	468.3209	531.0179	571.9720	602.2209	553.7988	410.1996	274.3808	287.1600	418.3009	471.5605	456.6712	449.4489	(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													
	1150.0635	1114.7131	1008.8317	840.3462	644.4885	426.9373	276.7548	291.1844	463.0372	707.3948	943.7656	1143.1748	(97)
Space heating kWh													
	507.2165	392.2432	325.0236	171.4502	67.4731	0.0000	0.0000	0.0000	0.0000	175.4607	350.7079	516.1321	(98a)
Space heating requirement - total per year (kWh/year)												2505.7074	
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													
	507.2165	392.2432	325.0236	171.4502	67.4731	0.0000	0.0000	0.0000	0.0000	175.4607	350.7079	516.1321	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2505.7074	
Space heating per m2											(98c) / (4) =	34.5806	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	714.9669	562.8463	576.7300	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8575	0.9190	0.8931	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	613.0761	517.2615	515.0995	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	770.7092	738.7757	689.7106	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	113.4959	164.8066	129.9106	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													

	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	28.3740	41.2016	32.4777	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement 102.0533 (107)
Energy for space heating 34.5806 (99)
Energy for space cooling 1.4084 (108)
Total 35.9890 (109)
Fabric Energy Efficiency (DFEE) 36.0 (109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	36.2300 (1b)	x	2.3100 (2b)	=	83.6913	(1b) - (3b)
First floor	36.2300 (1c)	x	2.6800 (2c)	=	97.0964	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	180.7877	(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)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1659	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4159	(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) =	0.3535	(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													
	0.4508	0.4419	0.4331	0.3889	0.3801	0.3359	0.3359	0.3270	0.3535	0.3801	0.3977	0.4154	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

Effective ac	0.6016	0.5977	0.5938	0.5756	0.5722	0.5564	0.5564	0.5535	0.5625	0.5722	0.5791	0.5863	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.20)			12.4600	1.1450	14.2672			(27)
GF			36.2300	0.1300	4.7099			(28a)
Main	84.9797	14.6100	70.3697	0.1800	12.6665			(29a)
PIJ	36.2300		36.2300	0.1100	3.9853			(30)
Total net area of external elements Aum(A, m2)			157.4397					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.7789			(33)
Party Wall 1			41.1200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 216.1010 (35)
List of Thermal Bridges

		Length	Psi-value	Total
K1	Element			
E2	Other lintels (including other steel lintels)	9.8500	0.0500	0.4925
E3	Sill	9.8500	0.0500	0.4925
E4	Jamb	17.4000	0.0500	0.8700
E5	Ground floor (normal)	17.0300	0.1600	2.7248
E6	Intermediate floor within a dwelling	17.0300	0.0000	0.0000
E16	Corner (normal)	9.9800	0.0900	0.8982
E18	Party wall between dwellings	9.9800	0.0600	0.5988
P1	Party wall - Ground floor	8.2400	0.0800	0.6592
E10	Eaves (insulation at ceiling level)	8.7900	0.0600	0.5274
E12	Gable (insulation at ceiling level)	8.2400	0.0600	0.4944
P4	Party wall - Roof (insulation at ceiling level)	8.2400	0.1200	0.9888

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.7466 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 46.5255 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.8914	35.6560	35.4253	34.3417	34.1389	33.1951	33.1951	33.0203	33.5586	34.1389	34.5491	34.9779	(38)
Heat transfer coeff													
	82.4169	82.1815	81.9508	80.8672	80.6644	79.7206	79.7206	79.5458	80.0842	80.6644	81.0746	81.5034	(39)

Average = Sum(39)m / 12 = 80.8662

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1374	1.1342	1.1310	1.1160	1.1132	1.1002	1.1002	1.0978	1.1052	1.1132	1.1189	1.1248	(40)
HLP (average)												1.1160	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3043 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

27.1533	26.7500	26.1821	25.1351	24.3510	23.4817	23.0121	23.5760	24.1900	25.1202	26.1889	27.0615	(42b)

Hot water usage for other uses

38.2287	36.8386	35.4484	34.0583	32.6682	31.2780	31.2780	32.6682	34.0583	35.4484	36.8386	38.2287	(42c)

Average daily hot water use (litres/day) 59.9287 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	65.3820	63.5886	61.6306	59.1934	57.0192	54.7597	54.2901	56.2441	58.2483	60.5687	63.0274	65.2902	(44)
Energy conte	103.5491	90.5493	94.7239	81.0328	76.7588	67.3334	65.6592	69.6420	71.8259	82.1911	89.7941	102.2286	(45)
Energy content (annual)										Total = Sum(45)m =		995.2882	
Distribution loss (46)m = 0.15 x (45)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	(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	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													
	88.0167	76.9669	80.5153	68.8778	65.2450	57.2334	55.8103	59.1957	61.0521	69.8624	76.3250	86.8944	(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													
	88.0167	76.9669	80.5153	68.8778	65.2450	57.2334	55.8103	59.1957	61.0521	69.8624	76.3250	86.8944	(64)
									Total per year (kWh/year) = Sum(64)m =			845.9950	(64)
12Total per year (kWh/year)												846	(64)
Electric shower(s)													
	50.3370	44.8507	48.9752	46.7365	47.6135	45.4186	46.9326	47.6135	46.7365	48.9752	48.0543	50.3370	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			572.5807	(64a)
Heat gains from water heating, kWh/month													
	34.5884	30.4544	32.3726	28.9036	28.2146	25.6630	25.6857	26.7023	26.9471	29.7094	31.0948	34.3078	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	115.2168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	105.3698	116.6595	105.3698	108.8822	105.3698	108.8822	105.3698	105.3698	108.8822	105.3698	108.8822	105.3698	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	202.9691	205.0753	199.7678	188.4687	174.2056	160.8004	151.8448	149.7387	155.0462	166.3453	180.6083	194.0136	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	34.5217	(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)													
	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	(71)
Water heating gains (Table 5)													
	46.4898	45.3190	43.5116	40.1439	37.9229	35.6431	34.5238	35.8902	37.4266	39.9320	43.1873	46.1127	(72)
Total internal gains													
	412.3938	424.6188	406.2142	395.0597	375.0634	362.8907	349.3035	348.5637	358.9200	369.2121	390.2428	403.0611	(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	
East	4.3300	19.6403	0.6300	0.7000	0.7700	25.9900	(76)
South	0.6000	46.7521	0.6300	0.7000	0.7700	8.5728	(78)
West	7.5300	19.6403	0.6300	0.7000	0.7700	45.1975	(80)

Solar gains	79.7603	153.2980	247.2225	354.6891	430.9761	439.8892	419.2997	362.3935	285.4120	180.3847	98.9242	65.9489	(83)
Total gains	492.1541	577.9168	653.4367	749.7488	806.0395	802.7799	768.6032	710.9572	644.3320	549.5969	489.1670	469.0100	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.7760	52.9271	53.0761	53.7874	53.9226	54.5610	54.5610	54.6808	54.3133	53.9226	53.6498	53.3675	
alpha	4.5184	4.5285	4.5384	4.5858	4.5948	4.6374	4.6374	4.6454	4.6209	4.5948	4.5767	4.5578	
util living area													
	0.9938	0.9866	0.9690	0.9109	0.7906	0.6049	0.4498	0.5030	0.7538	0.9455	0.9875	0.9950	(86)
MIT	19.5260	19.7483	20.0766	20.5069	20.8114	20.9588	20.9915	20.9861	20.8881	20.4670	19.9262	19.4967	(87)
Th 2	19.9704	19.9730	19.9756	19.9878	19.9900	20.0007	20.0007	20.0026	19.9966	19.9900	19.9854	19.9806	(88)
util rest of house													
	0.9920	0.9829	0.9601	0.8859	0.7372	0.5221	0.3509	0.3995	0.6765	0.9246	0.9833	0.9936	(89)
MIT 2	18.6359	18.8580	19.1822	19.5999	19.8657	19.9815	19.9983	19.9984	19.9358	19.5739	19.0454	18.6146	(90)
Living area fraction									fLA = Living area / (4) =			0.2099	(91)
MIT	18.8228	19.0449	19.3699	19.7903	20.0642	20.1866	20.2068	20.2057	20.1357	19.7613	19.2303	18.7997	(92)

Temperature adjustment												0.0000	
adjusted MIT	18.8228	19.0449	19.3699	19.7903	20.0642	20.1866	20.2068	20.2057	20.1357	19.7613	19.2303	18.7997	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9893	0.9783	0.9534	0.8802	0.7415	0.5381	0.3716	0.4211	0.6882	0.9188	0.9790	0.9913	(94)
Useful gains	486.8895	565.3831	622.9844	659.9014	597.6665	431.9840	285.6452	299.4095	443.4350	504.9464	478.8981	464.9069	(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	1196.9224	1162.4510	1054.7010	880.6662	674.6927	445.3705	287.5362	302.7298	483.3639	738.9943	983.4584	1189.9265	(97)
Space heating kWh	528.2645	401.2297	321.1972	158.9507	57.3075	0.0000	0.0000	0.0000	0.0000	174.1316	363.2834	539.4145	(98a)
Space heating requirement - total per year (kWh/year)												2543.7791	
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	528.2645	401.2297	321.1972	158.9507	57.3075	0.0000	0.0000	0.0000	0.0000	174.1316	363.2834	539.4145	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2543.7791	
Space heating per m2											(98c) / (4) =	35.1060	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	749.3737	589.9325	604.5483	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8875	0.9375	0.9141	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	665.0956	553.0811	552.6092	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	896.2364	858.4275	793.1235	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	166.4214	227.1777	178.9426	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	41.6053	56.7944	44.7357	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												143.1354	(107)
Energy for space heating												35.1060	(99)
Energy for space cooling												1.9754	(108)
Total												37.0813	(109)
Fabric Energy Efficiency (TFEE)												37.1	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	36.2300 (1b)	x	2.3100 (2b)	=	83.6913	(1b) - (3b)
First floor	36.2300 (1c)	x	2.6800 (2c)	=	97.0964	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	180.7877	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			12.4600	1.1450	14.2672			(27)
GF			36.2300	0.1100	3.9853	75.0000	2717.2500	(28a)
Main	84.9797	14.6100	70.3697	0.1800	12.6665	110.0000	7740.6669	(29a)
PIJ	36.2300		36.2300	0.1000	3.6230	9.0000	326.0700	(30)
Total net area of external elements Aum(A, m2)			157.4397					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.6920			(33)
Party Wall 1			41.1200	0.0000	0.0000	70.0000	2878.4000	(32)
Internal Wall 1			113.1200			9.0000	1018.0800	(32c)
Internal Floor 1			36.2300			18.0000	652.1400	(32d)
Internal Ceiling 1			36.2300			9.0000	326.0700	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 15658.6769 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 216.1010 (35)
List of Thermal Bridges

		Length	Psi-value	Total
K1	Element			
E2	Other lintels (including other steel lintels)	9.8500	0.0500	0.4925
E3	Sill	9.8500	0.0200	0.1970
E4	Jamb	17.4000	0.0160	0.2784
E5	Ground floor (normal)	17.0300	0.1000	1.7030
E6	Intermediate floor within a dwelling	17.0300	0.0000	0.0000
E16	Corner (normal)	9.9800	0.0510	0.5090
E18	Party wall between dwellings	9.9800	0.0290	0.2894
P1	Party wall - Ground floor	8.2400	0.0800	0.6592
E10	Eaves (insulation at ceiling level)	8.7900	0.1220	1.0724
E12	Gable (insulation at ceiling level)	8.2400	0.0770	0.6345
P4	Party wall - Roof (insulation at ceiling level)	8.2400	0.0410	0.3378

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1732 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 42.8652 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	31.0791	30.7622	30.4452	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	(38)
Heat transfer coeff	73.9443	73.6274	73.3104	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	(39)
Average = Sum(39)m / 12 =												72.9282	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0205	1.0161	1.0117	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	(40)
HLP (average)												1.0065	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3043 (42)
Hot water usage for mixer showers

62.8558	61.9112	60.5347	57.9011	55.9576	53.7901	52.5582	53.9242	55.4217	57.7488	60.4390	62.6150	(42a)

Hot water usage for baths

27.1533	26.7500	26.1821	25.1351	24.3510	23.4817	23.0121	23.5760	24.1900	25.1202	26.1889	27.0615	(42b)

Hot water usage for other uses

38.2287	36.8386	35.4484	34.0583	32.6682	31.2780	31.2780	32.6682	34.0583	35.4484	36.8386	38.2287	(42c)

Average daily hot water use (litres/day) 117.8797 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	128.2378	125.4998	122.1653	117.0945	112.9768	108.5498	106.8483	110.1684	113.6699	118.3175	123.4664	127.9052	(44)
Energy conte	203.0973	178.7100	187.7635	160.2965	152.0884	133.4747	129.2237	136.4114	140.1664	160.5557	175.9006	200.2686	(45)
Energy content (annual)										Total = Sum(45)m =		1957.9568	
Distribution loss (46)m = 0.15 x (45)m	30.4646	26.8065	28.1645	24.0445	22.8133	20.0212	19.3836	20.4617	21.0250	24.0834	26.3851	30.0403	(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	14.8262	13.3772	14.7802	14.2392	14.6732	14.1587	14.6046	14.6261	14.1788	14.6986	14.2860	14.8177	(61)
Total heat required for water heating calculated for each month	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(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	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
										Total per year (kWh/year) = Sum(64)m =		2131.2233	(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	71.2364	62.7654	66.1264	56.8584	54.2377	47.9200	46.6180	49.0133	50.1500	57.0594	62.0584	70.2937	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.9046	25.6728	20.8785	15.8064	11.8155	9.9751	10.7784	14.0102	18.8045	23.8766	27.8676	29.7079	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.9389	306.0825	298.1608	281.2965	260.0084	240.0006	226.6341	223.4905	231.4122	248.2765	269.5646	289.5725	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	(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)													
	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	(71)
Water heating gains (Table 5)													
	95.7479	93.4009	88.8796	78.9700	72.9001	66.5556	62.6586	65.8781	69.6528	76.6928	86.1923	94.4808	(72)
Total internal gains													
	527.8084	525.3732	508.1360	476.2900	444.9411	413.7483	397.2883	400.5960	417.0866	449.0630	483.8416	513.9783	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.3000	0.0000	0.7700	19.6448	(76)
South	0.6000	46.7521	0.3000	0.0000	0.7700	6.4798	(78)
West	7.5300	19.6403	0.3000	0.0000	0.7700	34.1629	(80)

Solar gains	60.2875	115.8715	186.8650	268.0945	325.7567	332.4938	316.9310	273.9180	215.7309	136.3452	74.7726	49.8480	(83)
Total gains	588.0959	641.2447	695.0011	744.3845	770.6978	746.2421	714.2192	674.5140	632.8175	585.4082	558.6142	563.8262	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.8231	59.0763	59.3317	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	
alpha	4.9215	4.9384	4.9554	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	
util living area													
	0.9862	0.9773	0.9542	0.8942	0.7742	0.5998	0.4433	0.4881	0.7240	0.9196	0.9761	0.9885	(86)
MIT	19.8854	20.0482	20.3182	20.6345	20.8643	20.9699	20.9945	20.9912	20.9258	20.6282	20.2053	19.8659	(87)
Th 2	20.0663	20.0699	20.0736	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	(88)
util rest of house													
	0.9826	0.9715	0.9423	0.8674	0.7226	0.5228	0.3530	0.3943	0.6501	0.8931	0.9688	0.9855	(89)
MIT 2	19.0656	19.2284	19.4935	19.7952	19.9913	20.0664	20.0791	20.0779	20.0407	19.7964	19.3932	19.0578	(90)
Living area fraction										fLA = Living area / (4) =		0.2099	(91)
MIT	19.2377	19.4005	19.6666	19.9714	20.1746	20.2561	20.2712	20.2696	20.2265	19.9710	19.5637	19.2274	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0877	19.2505	19.5166	19.8214	20.0246	20.1061	20.1212	20.1196	20.0765	19.8210	19.4137	19.0774	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9776	0.9648	0.9335	0.8587	0.7192	0.5250	0.3570	0.3984	0.6497	0.8840	0.9620	0.9811	(94)
Useful gains	574.9201	618.6791	648.7550	639.1827	554.3038	391.7662	254.9904	268.6950	411.1515	517.5093	537.3726	553.1418	(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													
	1093.4658	1056.5893	954.2522	793.9312	605.1555	400.2658	255.9747	270.3964	434.4618	670.3223	895.1451	1081.5153	(97)
Space heating kWh													
	385.7980	294.2757	227.2900	111.4189	37.8337	0.0000	0.0000	0.0000	0.0000	113.6929	257.5962	393.1098	(98a)
Space heating requirement - total per year (kWh/year)												1821.0152	
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													
	385.7980	294.2757	227.2900	111.4189	37.8337	0.0000	0.0000	0.0000	0.0000	113.6929	257.5962	393.1098	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1821.0152	
Space heating per m2											(98c) / (4) =	25.1313	(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 %)												89.0000	(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													
	385.7980	294.2757	227.2900	111.4189	37.8337	0.0000	0.0000	0.0000	0.0000	113.6929	257.5962	393.1098	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	433.4809	330.6468	255.3820	125.1898	42.5098	0.0000	0.0000	0.0000	0.0000	127.7448	289.4339	441.6964	(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													
	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.3788	88.3207	88.1908	87.9546	87.6095	87.3000	87.3000	87.3000	87.3000	87.9611	88.2699	88.3913	(217)
Fuel for water heating, kWh/month													
	246.5790	217.4882	229.6655	198.4383	190.3466	169.1104	164.7518	173.0098	176.7986	199.2407	215.4602	243.3343	(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	10.3104	9.3126	10.3104	9.9778	10.3104	9.9778	10.3104	10.3104	9.9778	10.3104	9.9778	10.3104	(231)
Lighting	25.3000	20.2966	18.2748	13.3889	10.3420	8.4495	9.4343	12.2631	15.9285	20.8991	23.6055	26.0032	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.2993	-35.1951	-56.9483	-70.1424	-79.3512	-75.2840	-74.0462	-67.8306	-56.8088	-42.6542	-25.5513	-18.6886	(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	(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	(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	(235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m	-8.8988	-21.7746	-52.0352	-91.4879	-132.5438	-137.7289	-134.1948	-106.2115	-68.3918	-33.5287	-12.4485	-6.7337 (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	(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	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2046.0845	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.3000	
Water heating fuel used	2424.2234	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 4.6540, total flow = 29.0000, SFP = 0.1605)		
mechanical ventilation fans (SFP = 0.1605)	35.3962	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	121.3962	(231)
Electricity for lighting (calculated in Appendix L)	204.1855	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1430.7783	(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	3365.1114	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2046.0845	3.6400	74.4775	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2424.2234	3.6400	88.2417	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	121.3962	16.4900	20.0182	(249)
Energy for lighting	204.1855	16.4900	33.6702	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-624.8000	16.4900	-103.0295	
PV Unit electricity exported	-805.9783	5.5900	-45.0542	
Total			-148.0837	(252)
Total energy cost			160.3239	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4914	(257)
SAP value		92.0349	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	2046.0845	0.2100	429.6777	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2424.2234	0.2100	509.0869	(264)
Space and water heating			938.7647	(265)
Pumps, fans and electric keep-hot	121.3962	0.1387	16.8392	(267)
Energy for lighting	204.1855	0.1443	29.4703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-624.8000	0.1328	-82.9702	
PV Unit electricity exported	-805.9783	0.1222	-98.4866	
Total			-181.4567	(269)
Total CO2, kg/year			803.6173	(272)
CO2 emissions per m2			11.0900	(273)
EI value			90.8322	
EI rating			91	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	36.2300 (1b)	x	2.3100 (2b)	=	83.6913 (1b) - (3b)	
First floor	36.2300 (1c)	x	2.6800 (2c)	=	97.0964 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	180.7877	(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	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
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		5.0000 (17)
Infiltration rate		0.2500 (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) =	0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			12.4600	1.1450	14.2672			(27)
GF			36.2300	0.1100	3.9853	75.0000	2717.2500	(28a)
Main	84.9797	14.6100	70.3697	0.1800	12.6665	110.0000	7740.6669	(29a)
PIJ	36.2300		36.2300	0.1000	3.6230	9.0000	326.0700	(30)
Total net area of external elements Aum(A, m2)			157.4397					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.6920			(33)
Party Wall 1			41.1200	0.0000	0.0000	70.0000	2878.4000	(32)
Internal Wall 1			113.1200			9.0000	1018.0800	(32c)
Internal Floor 1			36.2300			18.0000	652.1400	(32d)
Internal Ceiling 1			36.2300			9.0000	326.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15658.6769 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	216.1010 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.8500	0.0500	0.4925
E3 Sill	9.8500	0.0200	0.1970
E4 Jamb	17.4000	0.0160	0.2784
E5 Ground floor (normal)	17.0300	0.1000	1.7030
E6 Intermediate floor within a dwelling	17.0300	0.0000	0.0000
E16 Corner (normal)	9.9800	0.0510	0.5090
E18 Party wall between dwellings	9.9800	0.0290	0.2894
P1 Party wall - Ground floor	8.2400	0.0800	0.6592
E10 Eaves (insulation at ceiling level)	8.7900	0.1220	1.0724
E12 Gable (insulation at ceiling level)	8.2400	0.0770	0.6345
P4 Party wall - Roof (insulation at ceiling level)	8.2400	0.0410	0.3378

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.1732 (36)
Point Thermal bridges	(36a) = 0.0000
Total fabric heat loss	(33) + (36) + (36a) = 42.8652 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	(38)
Heat transfer coeff	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	(39)
Average = Sum(39)m / 12 =												72.6952	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	(40)
HLP (average)												1.0032	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3043	(42)
Hot water usage for mixer showers	62.8558	61.9112	60.5347	57.9011	55.9576	53.7901	52.5582	53.9242	55.4217	57.7488	60.4390	62.6150	(42a)
Hot water usage for baths	27.1533	26.7500	26.1821	25.1351	24.3510	23.4817	23.0121	23.5760	24.1900	25.1202	26.1889	27.0615	(42b)

Hot water usage for other uses

	38.2287	36.8386	35.4484	34.0583	32.6682	31.2780	31.2780	32.6682	34.0583	35.4484	36.8386	38.2287 (42c)

Average daily hot water use (litres/day) 117.8797 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	128.2378	125.4998	122.1653	117.0945	112.9768	108.5498	106.8483	110.1684	113.6699	118.3175	123.4664	127.9052	(44)
Energy conte	203.0973	178.7100	187.7635	160.2965	152.0884	133.4747	129.2237	136.4114	140.1664	160.5557	175.9006	200.2686	(45)
Energy content (annual)										Total = Sum(45)m =		1957.9568	
Distribution loss (46)m = 0.15 x (45)m	30.4646	26.8065	28.1645	24.0445	22.8133	20.0212	19.3836	20.4617	21.0250	24.0834	26.3851	30.0403	(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	14.8262	13.3772	14.7802	14.2392	14.6732	14.1587	14.6046	14.6261	14.1788	14.6986	14.2860	14.8177	(61)
Total heat required for water heating calculated for each month	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(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	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
									Total per year (kWh/year) = Sum(64)m =			2131.2233	(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	71.2364	62.7654	66.1264	56.8584	54.2377	47.9200	46.6180	49.0133	50.1500	57.0594	62.0584	70.2937	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.9046	25.6728	20.8785	15.8064	11.8155	9.9751	10.7784	14.0102	18.8045	23.8766	27.8676	29.7079	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.9389	306.0825	298.1608	281.2965	260.0084	240.0006	226.6341	223.4905	231.4122	248.2765	269.5646	289.5725	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	(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)	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	(71)
Water heating gains (Table 5)	95.7479	93.4009	88.8796	78.9700	72.9001	66.5556	62.6586	65.8781	69.6528	76.6928	86.1923	94.4808	(72)
Total internal gains	527.8084	525.3732	508.1360	476.2900	444.9411	413.7483	397.2883	400.5960	417.0866	449.0630	483.8416	513.9783	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	18.1295	0.3000	0.0000	0.7700	18.1336	(76)
South	0.6000	43.1558	0.3000	0.0000	0.7700	5.9814	(78)
West	7.5300	18.1295	0.3000	0.0000	0.7700	31.5350	(80)

Solar gains	55.6500	109.4342	173.2395	250.2216	312.1835	315.8691	303.5159	258.2157	204.4754	130.1477	70.2409	49.8480	(83)
Total gains	583.4584	634.8074	681.3755	726.5115	757.1246	729.6174	700.8042	658.8117	621.5620	579.2107	554.0825	563.8262	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	
alpha	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	
util living area	0.9850	0.9761	0.9521	0.8913	0.7615	0.5614	0.4119	0.4476	0.7105	0.9173	0.9748	0.9876	(86)
MIT	19.9576	20.0965	20.3573	20.6532	20.8797	20.9795	20.9964	20.9946	20.9348	20.6410	20.2338	19.9023	(87)
Th 2	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	(88)
util rest of house	0.9810	0.9698	0.9394	0.8629	0.7067	0.4793	0.3188	0.3497	0.6326	0.8896	0.9670	0.9843	(89)
MIT 2	19.1484	19.2845	19.5373	19.8128	20.0036	20.0720	20.0798	20.0792	20.0469	19.8084	19.4212	19.0939	(90)
Living area fraction									fLA = Living area / (4) =			0.2099	(91)
MIT	19.3183	19.4549	19.7094	19.9892	20.1875	20.2625	20.2722	20.2714	20.2333	19.9832	19.5918	19.2636	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1683	19.3049	19.5594	19.8392	20.0375	20.1125	20.1222	20.1214	20.0833	19.8332	19.4418	19.1136	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9757	0.9631	0.9306	0.8543	0.7039	0.4823	0.3231	0.3541	0.6329	0.8807	0.9599	0.9796	(94)
Useful gains	569.3061	611.3711	634.0675	620.6931	532.9634	351.8790	226.4115	233.3115	393.3801	510.0874	531.8803	552.3471	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W	1051.7742	1025.3596	920.2792	766.1520	577.0195	357.1138	226.9658	234.1797	413.1488	656.6683	875.3787	1062.3361	(97)
Space heating kWh	358.9563	278.2003	212.9416	104.7304	32.7777	0.0000	0.0000	0.0000	0.0000	109.0562	247.3188	379.4318	(98a)

Space heating requirement - total per year (kWh/year) 1723.4131

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	(98b)
Solar heating contribution - total per year (kWh/year)											0.0000	
Space heating kWh												
	358.9563	278.2003	212.9416	104.7304	32.7777	0.0000	0.0000	0.0000	0.0000	109.0562	247.3188	379.4318 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)											1723.4131	
Space heating per m2										(98c) / (4) =	23.7843	(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 %)											89.0000	(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													
	358.9563	278.2003	212.9416	104.7304	32.7777	0.0000	0.0000	0.0000	0.0000	109.0562	247.3188	379.4318	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	403.3217	312.5846	239.2602	117.6746	36.8289	0.0000	0.0000	0.0000	0.0000	122.5350	277.8863	426.3279	(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													
	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.3501	88.2977	88.1631	87.9299	87.5748	87.3000	87.3000	87.3000	87.3000	87.9444	88.2529	88.3774	(217)
Fuel for water heating, kWh/month													
	246.6591	217.5450	229.7376	198.4942	190.4219	169.1104	164.7518	173.0098	176.7986	199.2786	215.5017	243.3725	(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	10.3104	9.3126	10.3104	9.9778	10.3104	9.9778	10.3104	10.3104	9.9778	10.3104	9.9778	10.3104	(231)
Lighting	25.3000	20.2966	18.2748	13.3889	10.3420	8.4495	9.4343	12.2631	15.9285	20.8991	23.6055	26.0032	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-20.8629	-33.7039	-54.1124	-67.3871	-77.6688	-73.4704	-72.5330	-65.7579	-55.0065	-41.2739	-24.3041	-18.6886	(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	-7.9354	-20.1009	-46.9244	-83.4679	-125.3972	-128.8919	-126.8936	-98.3073	-63.6619	-31.4462	-11.3926	-6.7337	(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												1936.4192	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2424.6813	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 4.6540, total flow = 29.0000, SFP = 0.1605)													
mechanical ventilation fans (SFP = 0.1605)												35.3962	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												121.3962	(231)
Electricity for lighting (calculated in Appendix L)												204.1855	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1355.9223	(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												3330.7599	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1936.4192	4.8000	92.9481	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2424.6813	4.8000	116.3847	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	121.3962	21.5100	26.1123	(249)
Energy for lighting	204.1855	21.5100	43.9203	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-604.7694	21.5100	-130.0859	
PV Unit electricity exported	-751.1529	5.5900	-41.9894	
Total			-172.0753	(252)
Total energy cost			205.2901	(255)

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	1936.4192	0.2100	406.6480	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2424.6813	0.2100	509.1831	(264)
Space and water heating			915.8311	(265)
Pumps, fans and electric keep-hot	121.3962	0.1387	16.8392	(267)
Energy for lighting	204.1855	0.1443	29.4703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-604.7694	0.1327	-80.2338	
PV Unit electricity exported	-751.1529	0.1220	-91.6067	
Total			-171.8405	(269)
Total CO2, kg/year			790.3000	(272)

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	1936.4192	1.1300	2188.1537	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2424.6813	1.1300	2739.8898	(278)
Space and water heating			4928.0436	(279)
Pumps, fans and electric keep-hot	121.3962	1.5128	183.6482	(281)
Energy for lighting	204.1855	1.5338	313.1865	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-604.7694	1.4902	-901.2375	
PV Unit electricity exported	-751.1529	0.4475	-336.1090	
Total			-1237.3464	(283)
Total Primary energy kWh/year			4187.5319	(286)

SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating: A 92
Current environmental impact rating: B 91

N	Solar water heating	SAP increase too small
U	Solar photovoltaic panels	Already installed
V2	Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
(none)			
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.6	-£ 14	-121 kg (15.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: A 92
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, East Pennines):

	Current	Potential	Saving
Electricity	£70	£70	£0
Mains gas	£307	£307	£0
Space heating	£217	£217	£0
Water heating	£116	£116	£0
Lighting	£44	£44	£0
Generated (PV)	-£172	-£172	£0
Total cost of fuels	£205	£205	£0
Total cost of uses	£205	£205	£0
Delivered energy	46 kWh/m²	46 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes
CO2 emissions per m²	11 kg/m²	11 kg/m²	0 kg/m²
Primary energy	58 kWh/m²	58 kWh/m²	0 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	36.2300 (1b)	x	2.3100 (2b)	=	83.6913	(1b) - (3b)
First floor	36.2300 (1c)	x	2.6800 (2c)	=	97.0964	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.4600					(4)

Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 180.7877 (5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			12.4600	1.1450	14.2672			(27)
GF			36.2300	0.1100	3.9853	75.0000	2717.2500	(28a)
Main	84.9797	14.6100	70.3697	0.1800	12.6665	110.0000	7740.6669	(29a)
PIJ	36.2300		36.2300	0.1000	3.6230	9.0000	326.0700	(30)
Total net area of external elements Aum(A, m2)			157.4397					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.6920			(33)
Party Wall 1			41.1200	0.0000	0.0000	70.0000	2878.4000	(32)
Internal Wall 1			113.1200			9.0000	1018.0800	(32c)
Internal Floor 1			36.2300			18.0000	652.1400	(32d)
Internal Ceiling 1			36.2300			9.0000	326.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15658.6769 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		216.1010 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.8500	0.0500	0.4925
E3 Sill	9.8500	0.0200	0.1970
E4 Jamb	17.4000	0.0160	0.2784
E5 Ground floor (normal)	17.0300	0.1000	1.7030
E6 Intermediate floor within a dwelling	17.0300	0.0000	0.0000
E16 Corner (normal)	9.9800	0.0510	0.5090
E18 Party wall between dwellings	9.9800	0.0290	0.2894
P1 Party wall - Ground floor	8.2400	0.0800	0.6592
E10 Eaves (insulation at ceiling level)	8.7900	0.1220	1.0724
E12 Gable (insulation at ceiling level)	8.2400	0.0770	0.6345
P4 Party wall - Roof (insulation at ceiling level)	8.2400	0.0410	0.3378

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.1732 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	42.8652 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	31.0791	30.7622	30.4452	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	(38)
Heat transfer coeff	73.9443	73.6274	73.3104	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	(39)
Average = Sum(39)m / 12 =												72.9282	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0205	1.0161	1.0117	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	(40)
HLP (average)												1.0065	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3043	(42)

Hot water usage for mixer showers

	62.8558	61.9112	60.5347	57.9011	55.9576	53.7901	52.5582	53.9242	55.4217	57.7488	60.4390	62.6150	(42a)

Hot water usage for baths

	27.1533	26.7500	26.1821	25.1351	24.3510	23.4817	23.0121	23.5760	24.1900	25.1202	26.1889	27.0615	(42b)

Hot water usage for other uses

	38.2287	36.8386	35.4484	34.0583	32.6682	31.2780	31.2780	32.6682	34.0583	35.4484	36.8386	38.2287	(42c)
Average daily hot water use (litres/day)												117.8797	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	128.2378	125.4998	122.1653	117.0945	112.9768	108.5498	106.8483	110.1684	113.6699	118.3175	123.4664	127.9052	(44)

Energy conte	203.0973	178.7100	187.7635	160.2965	152.0884	133.4747	129.2237	136.4114	140.1664	160.5557	175.9006	200.2686	(45)
Energy content (annual)										Total = Sum(45)m =		1957.9568	
Distribution loss (46)m = 0.15 x (45)m													
	30.4646	26.8065	28.1645	24.0445	22.8133	20.0212	19.3836	20.4617	21.0250	24.0834	26.3851	30.0403	(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	14.8262	13.3772	14.7802	14.2392	14.6732	14.1587	14.6046	14.6261	14.1788	14.6986	14.2860	14.8177	(61)
Total heat required for water heating calculated for each month													
	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(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													
	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
										Total per year (kWh/year) = Sum(64)m =		2131.2233	(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													
	71.2364	62.7654	66.1264	56.8584	54.2377	47.9200	46.6180	49.0133	50.1500	57.0594	62.0584	70.2937	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	28.9046	25.6728	20.8785	15.8064	11.8155	9.9751	10.7784	14.0102	18.8045	23.8766	27.8676	29.7079	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	302.9389	306.0825	298.1608	281.2965	260.0084	240.0006	226.6341	223.4905	231.4122	248.2765	269.5646	289.5725	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	(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)													
	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	(71)
Water heating gains (Table 5)													
	95.7479	93.4009	88.8796	78.9700	72.9001	66.5556	62.6586	65.8781	69.6528	76.6928	86.1923	94.4808	(72)
Total internal gains													
	527.8084	525.3732	508.1360	476.2900	444.9411	413.7483	397.2883	400.5960	417.0866	449.0630	483.8416	513.9783	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.3000	0.0000	0.7700	19.6448	(76)
South	0.6000	46.7521	0.3000	0.0000	0.7700	6.4798	(78)
West	7.5300	19.6403	0.3000	0.0000	0.7700	34.1629	(80)

Solar gains	60.2875	115.8715	186.8650	268.0945	325.7567	332.4938	316.9310	273.9180	215.7309	136.3452	74.7726	49.8480	(83)
Total gains	588.0959	641.2447	695.0011	744.3845	770.6978	746.2421	714.2192	674.5140	632.8175	585.4082	558.6142	563.8262	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.8231	59.0763	59.3317	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	
alpha	4.9215	4.9384	4.9554	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	
util living area													
	0.9862	0.9773	0.9542	0.8942	0.7742	0.5998	0.4433	0.4881	0.7240	0.9196	0.9761	0.9885	(86)
MIT	19.8854	20.0482	20.3182	20.6345	20.8643	20.9699	20.9945	20.9912	20.9258	20.6282	20.2053	19.8659	(87)
Th 2	20.0663	20.0699	20.0736	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	(88)
util rest of house													
	0.9826	0.9715	0.9423	0.8674	0.7226	0.5228	0.3530	0.3943	0.6501	0.8931	0.9688	0.9855	(89)
MIT 2	19.0656	19.2284	19.4935	19.7952	19.9913	20.0664	20.0791	20.0779	20.0407	19.7964	19.3932	19.0578	(90)
Living area fraction										fLA = Living area / (4) =		0.2099	(91)
MIT	19.2377	19.4005	19.6666	19.9714	20.1746	20.2561	20.2712	20.2696	20.2265	19.9710	19.5637	19.2274	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0877	19.2505	19.5166	19.8214	20.0246	20.1061	20.1212	20.1196	20.0765	19.8210	19.4137	19.0774	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9776	0.9648	0.9335	0.8587	0.7192	0.5250	0.3570	0.3984	0.6497	0.8840	0.9620	0.9811	(94)
Useful gains	574.9201	618.6791	648.7550	639.1827	554.3038	391.7662	254.9904	268.6950	411.1515	517.5093	537.3726	553.1418	(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													
	1093.4658	1056.5893	954.2522	793.9312	605.1555	400.2658	255.9747	270.3964	434.4618	670.3223	895.1451	1081.5153	(97)
Space heating kWh													
	385.7980	294.2757	227.2900	111.4189	37.8337	0.0000	0.0000	0.0000	0.0000	113.6929	257.5962	393.1098	(98a)
Space heating requirement - total per year (kWh/year)												1821.0152	
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													
	385.7980	294.2757	227.2900	111.4189	37.8337	0.0000	0.0000	0.0000	0.0000	113.6929	257.5962	393.1098	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1821.0152	
Space heating per m2											(98c) / (4) =	25.1313	(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 %)												89.0000	(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													
	385.7980	294.2757	227.2900	111.4189	37.8337	0.0000	0.0000	0.0000	0.0000	113.6929	257.5962	393.1098	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	433.4809	330.6468	255.3820	125.1898	42.5098	0.0000	0.0000	0.0000	0.0000	127.7448	289.4339	441.6964	(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													
	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.3788	88.3207	88.1908	87.9546	87.6095	87.3000	87.3000	87.3000	87.3000	87.9611	88.2699	88.3913	(217)
Fuel for water heating, kWh/month													
	246.5790	217.4882	229.6655	198.4383	190.3466	169.1104	164.7518	173.0098	176.7986	199.2407	215.4602	243.3343	(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	10.3104	9.3126	10.3104	9.9778	10.3104	9.9778	10.3104	10.3104	9.9778	10.3104	9.9778	10.3104	(231)
Lighting	25.3000	20.2966	18.2748	13.3889	10.3420	8.4495	9.4343	12.2631	15.9285	20.8991	23.6055	26.0032	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.2993	-35.1951	-56.9483	-70.1424	-79.3512	-75.2840	-74.0462	-67.8306	-56.8088	-42.6542	-25.5513	-18.6886	(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	-8.8988	-21.7746	-52.0352	-91.4879	-132.5438	-137.7289	-134.1948	-106.2115	-68.3918	-33.5287	-12.4485	-6.7337	(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												2046.0845	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2424.2234	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 4.6540, total flow = 29.0000, SFP = 0.1605)													
mechanical ventilation fans (SFP = 0.1605)												35.3962	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												121.3962	(231)
Electricity for lighting (calculated in Appendix L)												204.1855	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1430.7783	(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												3365.1114	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2046.0845	3.6400	74.4775	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2424.2234	3.6400	88.2417	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	121.3962	16.4900	20.0182	(249)
Energy for lighting	204.1855	16.4900	33.6702	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-624.8000	16.4900	-103.0295	
PV Unit electricity exported	-805.9783	5.5900	-45.0542	
Total			-148.0837	(252)
Total energy cost			160.3239	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4914	(257)
SAP value		92.0349	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	2046.0845	0.2100	429.6777	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2424.2234	0.2100	509.0869	(264)
Space and water heating			938.7647	(265)
Pumps, fans and electric keep-hot	121.3962	0.1387	16.8392	(267)
Energy for lighting	204.1855	0.1443	29.4703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-624.8000	0.1328	-82.9702	
PV Unit electricity exported	-805.9783	0.1222	-98.4866	
Total			-181.4567	(269)
Total CO2, kg/year			803.6173	(272)
CO2 emissions per m2			11.0900	(273)
EI value			90.8322	
EI rating			91	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	36.2300	(1b)	x 2.3100	(2b) =	83.6913	(1b) - (3b)
First floor	36.2300	(1c)	x 2.6800	(2c) =	97.0964	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		180.7877	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)
Mechanical extract ventilation - decentralised													
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)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			12.4600	1.1450	14.2672			(27)
GF			36.2300	0.1100	3.9853	75.0000	2717.2500	(28a)
Main	84.9797	14.6100	70.3697	0.1800	12.6665	110.0000	7740.6669	(29a)
PIJ	36.2300		36.2300	0.1000	3.6230	9.0000	326.0700	(30)
Total net area of external elements Aum(A, m2)			157.4397					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.6920			(33)
Party Wall 1			41.1200	0.0000	0.0000	70.0000	2878.4000	(32)
Internal Wall 1			113.1200			9.0000	1018.0800	(32c)
Internal Floor 1			36.2300			18.0000	652.1400	(32d)
Internal Ceiling 1			36.2300			9.0000	326.0700	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		15658.6769	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							216.1010	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	9.8500	0.0500	0.4925	
E3 Sill	9.8500	0.0200	0.1970	
E4 Jamb	17.4000	0.0160	0.2784	
E5 Ground floor (normal)	17.0300	0.1000	1.7030	
E6 Intermediate floor within a dwelling	17.0300	0.0000	0.0000	
E16 Corner (normal)	9.9800	0.0510	0.5090	
E18 Party wall between dwellings	9.9800	0.0290	0.2894	
P1 Party wall - Ground floor	8.2400	0.0800	0.6592	
E10 Eaves (insulation at ceiling level)	8.7900	0.1220	1.0724	
E12 Gable (insulation at ceiling level)	8.2400	0.0770	0.6345	
P4 Party wall - Roof (insulation at ceiling level)	8.2400	0.0410	0.3378	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1732 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 42.8652 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	29.8300	(38)
Heat transfer coeff	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	72.6952	(39)

Average = Sum(39)m / 12 = 72.6952

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	1.0032	(40)
HLP (average)												1.0032	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3043 (42)

Hot water usage for mixer showers

62.8558	61.9112	60.5347	57.9011	55.9576	53.7901	52.5582	53.9242	55.4217	57.7488	60.4390	62.6150	(42a)

Hot water usage for baths

27.1533	26.7500	26.1821	25.1351	24.3510	23.4817	23.0121	23.5760	24.1900	25.1202	26.1889	27.0615	(42b)

Hot water usage for other uses

38.2287	36.8386	35.4484	34.0583	32.6682	31.2780	31.2780	32.6682	34.0583	35.4484	36.8386	38.2287	(42c)

Average daily hot water use (litres/day) 117.8797 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	128.2378	125.4998	122.1653	117.0945	112.9768	108.5498	106.8483	110.1684	113.6699	118.3175	123.4664	127.9052	(44)
Energy conte	203.0973	178.7100	187.7635	160.2965	152.0884	133.4747	129.2237	136.4114	140.1664	160.5557	175.9006	200.2686	(45)
Energy content (annual)										Total = Sum(45)m =		1957.9568	
Distribution loss (46)m = 0.15 x (45)m	30.4646	26.8065	28.1645	24.0445	22.8133	20.0212	19.3836	20.4617	21.0250	24.0834	26.3851	30.0403	(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	14.8262	13.3772	14.7802	14.2392	14.6732	14.1587	14.6046	14.6261	14.1788	14.6986	14.2860	14.8177	(61)
Total heat required for water heating calculated for each month	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(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	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
									Total per year (kWh/year) = Sum(64)m =			2131.2233	(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	71.2364	62.7654	66.1264	56.8584	54.2377	47.9200	46.6180	49.0133	50.1500	57.0594	62.0584	70.2937	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	138.2602	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.9046	25.6728	20.8785	15.8064	11.8155	9.9751	10.7784	14.0102	18.8045	23.8766	27.8676	29.7079	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.9389	306.0825	298.1608	281.2965	260.0084	240.0006	226.6341	223.4905	231.4122	248.2765	269.5646	289.5725	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	51.1304	(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)	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	-92.1734	(71)
Water heating gains (Table 5)	95.7479	93.4009	88.8796	78.9700	72.9001	66.5556	62.6586	65.8781	69.6528	76.6928	86.1923	94.4808	(72)
Total internal gains	527.8084	525.3732	508.1360	476.2900	444.9411	413.7483	397.2883	400.5960	417.0866	449.0630	483.8416	513.9783	(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	
East	4.3300	18.1295	0.3000	0.0000	0.7700	18.1336	(76)
South	0.6000	43.1558	0.3000	0.0000	0.7700	5.9814	(78)
West	7.5300	18.1295	0.3000	0.0000	0.7700	31.5350	(80)

Solar gains	55.6500	109.4342	173.2395	250.2216	312.1835	315.8691	303.5159	258.2157	204.4754	130.1477	70.2409	49.8480	(83)
Total gains	583.4584	634.8074	681.3755	726.5115	757.1246	729.6174	700.8042	658.8117	621.5620	579.2107	554.0825	563.8262	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	59.8338	
alpha	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	4.9889	
util living area	0.9850	0.9761	0.9521	0.8913	0.7615	0.5614	0.4119	0.4476	0.7105	0.9173	0.9748	0.9876	(86)
MIT	19.9576	20.0965	20.3573	20.6532	20.8797	20.9795	20.9964	20.9946	20.9348	20.6410	20.2338	19.9023	(87)
Th 2	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	20.0806	(88)
util rest of house	0.9810	0.9698	0.9394	0.8629	0.7067	0.4793	0.3188	0.3497	0.6326	0.8896	0.9670	0.9843	(89)
MIT 2	19.1484	19.2845	19.5373	19.8128	20.0036	20.0720	20.0798	20.0792	20.0469	19.8084	19.4212	19.0939	(90)
Living area fraction										fLA = Living area / (4) =		0.2099	(91)
MIT	19.3183	19.4549	19.7094	19.9892	20.1875	20.2625	20.2722	20.2714	20.2333	19.9832	19.5918	19.2636	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1683	19.3049	19.5594	19.8392	20.0375	20.1125	20.1222	20.1214	20.0833	19.8332	19.4418	19.1136	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9757	0.9631	0.9306	0.8543	0.7039	0.4823	0.3231	0.3541	0.6329	0.8807	0.9599	0.9796	(94)
Useful gains	569.3061	611.3711	634.0675	620.6931	532.9634	351.8790	226.4115	233.3115	393.3801	510.0874	531.8803	552.3471	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W	1051.7742	1025.3596	920.2792	766.1520	577.0195	357.1138	226.9658	234.1797	413.1488	656.6683	875.3787	1062.3361	(97)
Space heating kWh	358.9563	278.2003	212.9416	104.7304	32.7777	0.0000	0.0000	0.0000	0.0000	109.0562	247.3188	379.4318	(98a)
Space heating requirement - total per year (kWh/year)												1723.4131	
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	358.9563	278.2003	212.9416	104.7304	32.7777	0.0000	0.0000	0.0000	0.0000	109.0562	247.3188	379.4318	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1723.4131	
Space heating per m2											(98c) / (4) =	23.7843	(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 %)												89.0000	(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	358.9563	278.2003	212.9416	104.7304	32.7777	0.0000	0.0000	0.0000	0.0000	109.0562	247.3188	379.4318	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	403.3217	312.5846	239.2602	117.6746	36.8289	0.0000	0.0000	0.0000	0.0000	122.5350	277.8863	426.3279	(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	217.9235	192.0872	202.5437	174.5357	166.7616	147.6334	143.8283	151.0376	154.3452	175.2543	190.1866	215.0863	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.3501	88.2977	88.1631	87.9299	87.5748	87.3000	87.3000	87.3000	87.3000	87.9444	88.2529	88.3774	(217)
Fuel for water heating, kWh/month	246.6591	217.5450	229.7376	198.4942	190.4219	169.1104	164.7518	173.0098	176.7986	199.2786	215.5017	243.3725	(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	10.3104	9.3126	10.3104	9.9778	10.3104	9.9778	10.3104	10.3104	9.9778	10.3104	9.9778	10.3104	(231)
Lighting	25.3000	20.2966	18.2748	13.3889	10.3420	8.4495	9.4343	12.2631	15.9285	20.8991	23.6055	26.0032	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-20.8629	-33.7039	-54.1124	-67.3871	-77.6688	-73.4704	-72.5330	-65.7579	-55.0065	-41.2739	-24.3041	-18.6886	(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	-7.9354	-20.1009	-46.9244	-83.4679	-125.3972	-128.8919	-126.8936	-98.3073	-63.6619	-31.4462	-11.3926	-6.7337	(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												1936.4192	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2424.6813	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 4.6540, total flow = 29.0000, SFP = 0.1605)													
mechanical ventilation fans (SFP = 0.1605)												35.3962	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												121.3962	(231)
Electricity for lighting (calculated in Appendix L)												204.1855	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1355.9223	(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	3330.7599	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1936.4192	4.8000	92.9481	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2424.6813	4.8000	116.3847	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	121.3962	21.5100	26.1123	(249)
Energy for lighting	204.1855	21.5100	43.9203	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-604.7694	21.5100	-130.0859	
PV Unit electricity exported	-751.1529	5.5900	-41.9894	
Total			-172.0753	(252)
Total energy cost			205.2901	(255)

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	1936.4192	0.2100	406.6480	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2424.6813	0.2100	509.1831	(264)
Space and water heating			915.8311	(265)
Pumps, fans and electric keep-hot	121.3962	0.1387	16.8392	(267)
Energy for lighting	204.1855	0.1443	29.4703	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-604.7694	0.1327	-80.2338	
PV Unit electricity exported	-751.1529	0.1220	-91.6067	
Total			-171.8405	(269)
Total CO2, kg/year			790.3000	(272)

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	1936.4192	1.1300	2188.1537	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2424.6813	1.1300	2739.8898	(278)
Space and water heating			4928.0436	(279)
Pumps, fans and electric keep-hot	121.3962	1.5128	183.6482	(281)
Energy for lighting	204.1855	1.5338	313.1865	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-604.7694	1.4902	-901.2375	
PV Unit electricity exported	-751.1529	0.4475	-336.1090	
Total			-1237.3464	(283)
Total Primary energy kWh/year			4187.5319	(286)

Full SAP Calculation Printout

Property Reference	HL0847-Semi	**Issued on Date**	16/11/2023
Assessment Reference	001	**Prop Type Ref**	HT-HL847 (Semi)
Property	S63 0JF		

SAP Rating	93 A	**DER**	10.85	**TER**	11.35
Environmental	91 B	**% DER < TER**			4.41
CO_2 Emissions (t/year)	0.84	**DFEE**	34.83	**TFEE**	35.87
Compliance Check	See BREL	**% DFEE < TFEE**			2.89
% DPER < TPER	3.12	**DPER**	57.41	**TPER**	59.26

Assessor Details	Mr. Paul Goddard	**Assessor ID**	B342-0001
Client	Hoober Homes, Hoober Homes		

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.7300 (1b)	x	2.3100 (2b)	=	96.3963	(1b) - (3b)
First floor	41.7300 (1c)	x	2.6900 (2c)	=	112.2537	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	208.6500	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised		
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)

Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			41.7300	0.1100	4.5903	75.0000	3129.7500	(28a)
Main	91.3500	16.4300	74.9200	0.1800	13.4856	110.0000	8241.1999	(29a)
PIJ	41.7300		41.7300	0.1000	4.1730	9.0000	375.5700	(30)
Total net area of external elements Aum(A, m2)			174.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.7500			(33)
Party Wall 1			45.7000	0.0000	0.0000	70.0000	3199.0000	(32)
Internal Wall 1			161.5900			9.0000	1454.3100	(32c)
Internal Floor 1			41.7300			18.0000	751.1400	(32d)
Internal Ceiling 1			41.7300			9.0000	375.5700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17526.5399 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		209.9993 (35)
List of Thermal Bridges		

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790	
E3 Sill	11.5800	0.0200	0.2316	
E4 Jamb	26.1000	0.0160	0.4176	
E5 Ground floor (normal)	18.2700	0.1000	1.8270	
E6 Intermediate floor within a dwelling	18.2700	0.0000	0.0000	
E16 Corner (normal)	10.0000	0.0510	0.5100	
E18 Party wall between dwellings	10.0000	0.0290	0.2900	
P1 Party wall - Ground floor	9.1400	0.0800	0.7312	
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139	
E12 Gable (insulation at ceiling level)	9.1400	0.0770	0.7038	
P4 Party wall - Roof (insulation at ceiling level)	9.1400	0.0410	0.3747	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			6.7788	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	47.5288	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.8689	35.5031	35.1373	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	(38)
Heat transfer coeff	83.3977	83.0319	82.6661	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	(39)
Average = Sum(39)m / 12 =												82.2250	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9993	0.9949	0.9905	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	(40)
HLP (average)												0.9852	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5252 (42)

Hot water usage for mixer showers

66.5597	65.5595	64.1019	61.3131	59.2550	56.9598	55.6553	57.1018	58.6875	61.1518	64.0005	66.3047	(42a)

Hot water usage for baths

28.7461	28.3192	27.7180	26.6095	25.7795	24.8591	24.3620	24.9589	25.6089	26.5938	27.7251	28.6489	(42b)

Hot water usage for other uses

40.4910	39.0186	37.5462	36.0738	34.6014	33.1290	33.1290	34.6014	36.0738	37.5462	39.0186	40.4910	(42c)

Average daily hot water use (litres/day) 124.8280 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	135.7968	132.8972	129.3660	123.9963	119.6358	114.9479	113.1462	116.6622	120.3703	125.2918	130.7442	135.4446	(44)
Energy conte	215.0689	189.2439	198.8308	169.7448	161.0528	141.3419	136.8406	144.4521	148.4286	170.0197	186.2691	212.0735	(45)
Energy content (annual)										Total = Sum(45)m =		2073.3666	
Distribution loss (46)m = 0.15 x (45)m	32.2603	28.3866	29.8246	25.4617	24.1579	21.2013	20.5261	21.6678	22.2643	25.5030	27.9404	31.8110	(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	14.8621	13.4088	14.8134	14.2675	14.7001	14.1823	14.6274	14.6503	14.2036	14.7270	14.3171	14.8531	(61)
Total heat required for water heating calculated for each month	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(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	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
										Total per year (kWh/year) = Sum(64)m =		2246.9794	(64)
12Total per year (kWh/year)												2247	(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	75.2259	66.2758	69.8146	60.0070	57.2251	50.5418	49.1563	51.6929	52.9034	60.2133	65.5137	74.2277	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.7004	130.3112	117.7004	121.6238	117.7004	121.6238	117.7004	117.7004	121.6238	117.7004	121.6238	117.7004	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	226.5197	228.8702	222.9469	210.3368	194.4188	179.4581	169.4635	167.1129	173.0363	185.6464	201.5644	216.5250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	(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)	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	(71)
Water heating gains (Table 5)	101.1101	98.6247	93.8368	83.3431	76.9154	70.1969	66.0704	69.4797	73.4769	80.9319	90.9913	99.7684	(72)
Total internal gains	509.2089	521.6847	498.3628	479.1823	452.9133	432.1574	414.1129	415.1717	429.0156	448.1573	478.0581	497.8725	(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	
East	5.1600	19.6403	0.3000	0.0000	0.7700	23.4104	(76)
South	1.8000	46.7521	0.3000	0.0000	0.7700	19.4395	(78)
West	7.3200	19.6403	0.3000	0.0000	0.7700	33.2101	(80)

Solar gains	76.0600	142.5987	222.9634	311.8679	373.7961	379.7183	362.6573	316.5542	254.5131	165.7672	93.6416	63.3595	(83)
Total gains	585.2689	664.2834	721.3262	791.0502	826.7094	811.8757	776.7702	731.7259	683.5286	613.9245	571.6997	561.2320	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.3767	58.6339	58.8933	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	
alpha	4.8918	4.9089	4.9262	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	
util living area	0.9916	0.9835	0.9657	0.9109	0.7967	0.6178	0.4587	0.5057	0.7449	0.9360	0.9834	0.9931	(86)
MIT	19.7667	19.9614	20.2363	20.5869	20.8422	20.9650	20.9934	20.9894	20.9142	20.5768	20.1208	19.7512	(87)
Th 2	20.0840	20.0876	20.0913	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	(88)
util rest of house	0.9894	0.9792	0.9565	0.8875	0.7480	0.5413	0.3674	0.4112	0.6734	0.9140	0.9783	0.9912	(89)
MIT 2	18.9647	19.1598	19.4318	19.7697	19.9919	20.0814	20.0964	20.0949	20.0507	19.7672	19.3274	18.9606	(90)
Living area fraction										fLA = Living area / (4) =		0.1757	(91)
MIT	19.1055	19.3006	19.5731	19.9133	20.1412	20.2366	20.2540	20.2521	20.2024	19.9095	19.4667	19.0995	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9555	19.1506	19.4231	19.7633	19.9912	20.0866	20.1040	20.1021	20.0524	19.7595	19.3167	18.9495	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9856	0.9733	0.9480	0.8773	0.7417	0.5403	0.3680	0.4115	0.6694	0.9038	0.9724	0.9880	(94)
Useful gains	576.8427	646.5740	683.8218	694.0160	613.1424	438.6306	285.8672	301.1399	457.5665	554.8653	555.9186	554.4750	(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	1222.2381	1183.2525	1068.3037	890.3103	679.5181	449.6604	287.1711	303.4062	487.8313	750.6729	1001.2358	1208.8100	(97)
Space heating kWh	480.1742	360.6480	286.0545	141.3319	49.3835	0.0000	0.0000	0.0000	0.0000	145.6809	320.6284	486.8253	(98a)
Space heating requirement - total per year (kWh/year)												2270.7266	
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	480.1742	360.6480	286.0545	141.3319	49.3835	0.0000	0.0000	0.0000	0.0000	145.6809	320.6284	486.8253	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2270.7266	
Space heating per m2											(98c) / (4) =	27.2074	(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 %) 89.0000 (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	480.1742	360.6480	286.0545	141.3319	49.3835	0.0000	0.0000	0.0000	0.0000	145.6809	320.6284	486.8253	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	539.5216	405.2224	321.4096	158.7999	55.4871	0.0000	0.0000	0.0000	0.0000	163.6864	360.2566	546.9947	(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	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4423	88.3808	88.2651	88.0304	87.6673	87.3000	87.3000	87.3000	87.3000	88.0414	88.3380	88.4524	(217)
Fuel for water heating, kWh/month	259.9785	229.2948	242.0482	209.0326	200.4771	178.1491	173.5028	182.2479	186.2911	209.8406	227.0667	256.5523	(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	10.6920	9.6572	10.6920	10.3471	10.6920	10.3471	10.6920	10.6920	10.3471	10.6920	10.3471	10.6920	(231)
Lighting	29.1614	23.3943	21.0640	15.4324	11.9204	9.7391	10.8742	14.1347	18.3596	24.0888	27.2082	29.9719	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.4563	-41.5010	-66.6692	-81.4430	-91.5103	-86.5645	-85.1516	-78.3352	-66.0689	-50.0733	-30.2342	-22.1981	(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	-11.0765	-27.0362	-64.4430	-113.0057	-163.4091	-169.6998	-165.3718	-131.0455	-84.5531	-41.5782	-15.4812	-8.3861	(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 2551.3782 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 87.3000

Water heating fuel used 2554.4819 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)

mechanical ventilation fans (SFP = 0.1567) 39.8891 (230a)

central heating pump 41.0000 (230c)

main heating flue fan 45.0000 (230e)

Total electricity for the above, kWh/year	125.8891	(231)
Electricity for lighting (calculated in Appendix L)	235.3489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1721.2916	(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	3745.8065	(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	2551.3782	0.2100	535.7894	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2554.4819	0.2100	536.4412	(264)
Space and water heating			1072.2306	(265)
Pumps, fans and electric keep-hot	125.8891	0.1387	17.4624	(267)
Energy for lighting	235.3489	0.1443	33.9681	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-726.2055	0.1329	-96.5458	
PV Unit electricity exported	-995.0861	0.1223	-121.6517	
Total			-218.1974	(269)
Total CO2, kg/year			905.4637	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.8500	(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	2551.3782	1.1300	2883.0574	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2554.4819	1.1300	2886.5645	(278)
Space and water heating			5769.6219	(279)
Pumps, fans and electric keep-hot	125.8891	1.5128	190.4451	(281)
Energy for lighting	235.3489	1.5338	360.9861	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-726.2055	1.4913	-1082.9604	
PV Unit electricity exported	-995.0861	0.4486	-446.3702	
Total			-1529.3307	(283)
Total Primary energy kWh/year			4791.7224	(286)
Dwelling Primary energy Rate (DPER)			57.4100	(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		41.7300 (1b)	x	2.3100 (2b)	=	96.3963	(1b) - (3b)
First floor		41.7300 (1c)	x	2.6900 (2c)	=	112.2537	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.4600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	208.6500	(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)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1438	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3938	(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) =	0.3347	(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													
	0.4268	0.4184	0.4100	0.3682	0.3598	0.3180	0.3180	0.3096	0.3347	0.3598	0.3766	0.3933	(22b)
Effective ac	0.5911	0.5875	0.5841	0.5678	0.5647	0.5506	0.5506	0.5479	0.5560	0.5647	0.5709	0.5773	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			41.7300	0.1300	5.4249			(28a)
Main	91.3500	16.4300	74.9200	0.1800	13.4856			(29a)
PIJ	41.7300		41.7300	0.1100	4.5903			(30)
Total net area of external elements Aum(A, m2)			174.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.0019			(33)
Party Wall 1			45.7000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 209.9993 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0500	0.5790
E4 Jamb	26.1000	0.0500	1.3050
E5 Ground floor (normal)	18.2700	0.1600	2.9232
E6 Intermediate floor within a dwelling	18.2700	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0900	0.9000
E18 Party wall between dwellings	10.0000	0.0600	0.6000
P1 Party wall - Ground floor	9.1400	0.0800	0.7312
E10 Eaves (insulation at ceiling level)	9.1300	0.0600	0.5478
E12 Gable (insulation at ceiling level)	9.1400	0.0600	0.5484
P4 Party wall - Roof (insulation at ceiling level)	9.1400	0.1200	1.0968

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.8104 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 51.8123 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.6973	40.4538	40.2152	39.0942	38.8845	37.9082	37.9082	37.7274	38.2843	38.8845	39.3088	39.7523	(38)
Heat transfer coeff	92.5096	92.2662	92.0275	90.9066	90.6969	89.7205	89.7205	89.5397	90.0966	90.6969	91.1211	91.5647	(39)
Average = Sum(39)m / 12 =												90.9056	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1084	1.1055	1.1027	1.0892	1.0867	1.0750	1.0750	1.0728	1.0795	1.0867	1.0918	1.0971	(40)
HLP (average)												1.0892	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5252 (42)

Hot water usage for mixer showers

66.5597	65.5595	64.1019	61.3131	59.2550	56.9598	55.6553	57.1018	58.6875	61.1518	64.0005	66.3047	(42a)

Hot water usage for baths

28.7461	28.3192	27.7180	26.6095	25.7795	24.8591	24.3620	24.9589	25.6089	26.5938	27.7251	28.6489	(42b)

Hot water usage for other uses

40.4910	39.0186	37.5462	36.0738	34.6014	33.1290	33.1290	34.6014	36.0738	37.5462	39.0186	40.4910	(42c)

Average daily hot water use (litres/day) 124.8280 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	135.7968	132.8972	129.3660	123.9963	119.6358	114.9479	113.1462	116.6622	120.3703	125.2918	130.7442	135.4446	(44)
Energy conte	215.0689	189.2439	198.8308	169.7448	161.0528	141.3419	136.8406	144.4521	148.4286	170.0197	186.2691	212.0735	(45)
Energy content (annual)										Total = Sum(45)m =		2073.3666	
Distribution loss (46)m = 0.15 x (45)m	32.2603	28.3866	29.8246	25.4617	24.1579	21.2013	20.5261	21.6678	22.2643	25.5030	27.9404	31.8110	(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	266.0278	235.2713	249.7897	219.0599	212.0117	190.6569	187.7995	195.4110	197.7436	220.9786	235.5842	263.0324	(62)
WWHRS	-30.4283	-26.9111	-28.1797	-23.3339	-21.7464	-18.6085	-17.4425	-18.5484	-19.2531	-22.6973	-25.7133	-29.8648	(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	235.5995	208.3602	221.6100	195.7259	190.2654	172.0484	170.3569	176.8626	178.4905	198.2814	209.8709	233.1676	(64)
										Total per year (kWh/year) = Sum(64)m =		2390.6394	(64)
12Total per year (kWh/year)												2391	(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	84.2501	74.4304	78.8510	68.7689	66.2898	59.3249	58.2392	60.7701	61.6813	69.2713	74.2632	83.2542	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.7004	130.3112	117.7004	121.6238	117.7004	121.6238	117.7004	117.7004	121.6238	117.7004	121.6238	117.7004	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	226.5197	228.8702	222.9469	210.3368	194.4188	179.4581	169.4635	167.1129	173.0363	185.6464	201.5644	216.5250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	(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)													

	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	(71)
Water heating gains (Table 5)													
	113.2394	110.7596	105.9825	95.5124	89.0992	82.3958	78.2785	81.6802	85.6684	93.1066	103.1434	111.9008	(72)
Total internal gains													
	521.3382	533.8196	510.5084	491.3516	465.0970	444.3563	426.3210	427.3721	441.2071	460.3320	490.2101	510.0048	(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	
East	5.1600	19.6403	0.6300	0.7000	0.7700	30.9720	(76)
South	1.8000	46.7521	0.6300	0.7000	0.7700	25.7185	(78)
West	7.3200	19.6403	0.6300	0.7000	0.7700	43.9370	(80)

Solar gains	100.6274	188.6580	294.9806	412.6012	494.5322	502.3673	479.7956	418.8013	336.7208	219.3101	123.8878	83.8246	(83)
Total gains	621.9656	722.4777	805.4890	903.9528	959.6293	946.7235	906.1167	846.1734	777.9279	679.6421	614.0980	593.8294	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.6268	52.7656	52.9025	53.5548	53.6786	54.2627	54.2627	54.3723	54.0363	53.6786	53.4287	53.1699	
alpha	4.5085	4.5177	4.5268	4.5703	4.5786	4.6175	4.6175	4.6248	4.6024	4.5786	4.5619	4.5447	
util living area													
	0.9901	0.9798	0.9570	0.8907	0.7641	0.5813	0.4303	0.4777	0.7192	0.9258	0.9807	0.9918	(86)
MIT	19.6219	19.8459	20.1631	20.5609	20.8358	20.9643	20.9928	20.9885	20.9072	20.5320	20.0112	19.5886	(87)
Th 2	19.9940	19.9963	19.9987	20.0096	20.0117	20.0213	20.0213	20.0231	20.0176	20.0117	20.0075	20.0032	(88)
util rest of house													
	0.9874	0.9745	0.9456	0.8628	0.7102	0.5020	0.3372	0.3806	0.6423	0.9002	0.9747	0.9896	(89)
MIT 2	18.3995	18.6845	19.0828	19.5700	19.8733	19.9998	20.0187	20.0185	19.9534	19.5494	18.9043	18.3637	(90)
Living area fraction										fLA = Living area / (4) =		0.1757	(91)
MIT	18.6142	18.8885	19.2726	19.7441	20.0424	20.1693	20.1898	20.1889	20.1209	19.7220	19.0987	18.5789	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6142	18.8885	19.2726	19.7441	20.0424	20.1693	20.1898	20.1889	20.1209	19.7220	19.0987	18.5789	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9821	0.9666	0.9351	0.8541	0.7120	0.5144	0.3535	0.3974	0.6510	0.8911	0.9671	0.9851	(94)
Useful gains	610.8613	698.3713	753.2025	772.0752	683.2245	486.9870	320.3207	336.2712	506.4425	605.6166	593.9087	584.9784	(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													
	1324.2028	1290.6673	1175.4288	985.8001	756.6287	499.6768	322.0754	339.2553	542.4671	827.3389	1093.3386	1316.5956	(97)
Space heating kWh													
	530.7260	398.0229	314.1363	153.8819	54.6128	0.0000	0.0000	0.0000	0.0000	164.9614	359.5895	544.3232	(98a)
Space heating requirement - total per year (kWh/year)												2520.2542	
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													
	530.7260	398.0229	314.1363	153.8819	54.6128	0.0000	0.0000	0.0000	0.0000	164.9614	359.5895	544.3232	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2520.2542	
Space heating per m2											(98c) / (4) =	30.1972	(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													
	530.7260	398.0229	314.1363	153.8819	54.6128	0.0000	0.0000	0.0000	0.0000	164.9614	359.5895	544.3232	(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)													
	574.3788	430.7607	339.9744	166.5389	59.1047	0.0000	0.0000	0.0000	0.0000	178.5297	389.1662	589.0944	(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													
	235.5995	208.3602	221.6100	195.7259	190.2654	172.0484	170.3569	176.8626	178.4905	198.2814	209.8709	233.1676	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.0662	85.7446	85.1287	83.8712	82.0706	80.3000	80.3000	80.3000	80.3000	83.9899	85.5243	86.1335	(217)
Fuel for water heating, kWh/month													
	273.7423	243.0010	260.3234	233.3649	231.8312	214.2571	212.1506	220.2524	222.2796	236.0778	245.3932	270.7048	(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	24.4558	19.6194	17.6651	12.9422	9.9969	8.1676	9.1195	11.8539	15.3970	20.2018	22.8178	25.1355	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-38.7758	-54.5294	-78.1863	-87.6825	-94.3529	-87.9883	-86.8867	-82.1120	-73.6684	-62.2313	-42.5752	-33.5389	(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	-22.3251	-46.9181	-93.1734	-139.8307	-184.7934	-185.6491	-183.4773	-155.4060	-113.9741	-67.0765	-29.7995	-17.6588	(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	2727.5478	(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	2863.3783	(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)	197.3725	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2062.6098	(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	3811.6888	(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	2727.5478	0.2100	572.7850	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2863.3783	0.2100	601.3094	(264)
Space and water heating			1174.0945	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	197.3725	0.1443	28.4870	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-822.5279	0.1346	-110.7471	
PV Unit electricity exported	-1240.0819	0.1259	-156.1480	
Total			-266.8951	(269)
Total CO2, kg/year			947.6155	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.3500	(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	2727.5478	1.1300	3082.1290	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2863.3783	1.1300	3235.6175	(278)
Space and water heating			6317.7465	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	197.3725	1.5338	302.7366	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-822.5279	1.4976	-1231.8332	
PV Unit electricity exported	-1240.0819	0.4622	-573.1717	
Total			-1805.0049	(283)
Total Primary energy kWh/year			4945.5790	(286)
Target Primary Energy Rate (TPER)			59.2600	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		41.7300 (1b)	x	2.3100 (2b)	=	96.3963	(1b) - (3b)
First floor		41.7300 (1c)	x	2.6900 (2c)	=	112.2537	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.4600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	208.6500	(5)

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2. Ventilation rate

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		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)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1438 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3938 (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) =	0.3347 (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	0.4268	0.4184	0.4100	0.3682	0.3598	0.3180	0.3180	0.3096	0.3347	0.3598	0.3766	0.3933	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		0.0000 (23c)

Effective ac	0.5911	0.5875	0.5841	0.5678	0.5647	0.5506	0.5506	0.5479	0.5560	0.5647	0.5709	0.5773	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			41.7300	0.1100	4.5903	75.0000	3129.7500	(28a)
Main	91.3500	16.4300	74.9200	0.1800	13.4856	110.0000	8241.1999	(29a)
PIJ	41.7300		41.7300	0.1000	4.1730	9.0000	375.5700	(30)
Total net area of external elements Aum(A, m2)			174.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.7500			(33)
Party Wall 1			45.7000	0.0000	0.0000	70.0000	3199.0000	(32)
Internal Wall 1			161.5900			9.0000	1454.3100	(32c)
Internal Floor 1			41.7300			18.0000	751.1400	(32d)
Internal Ceiling 1			41.7300			9.0000	375.5700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17526.5399 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		209.9993 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0200	0.2316
E4 Jamb	26.1000	0.0160	0.4176
E5 Ground floor (normal)	18.2700	0.1000	1.8270
E6 Intermediate floor within a dwelling	18.2700	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0510	0.5100
E18 Party wall between dwellings	10.0000	0.0290	0.2900
P1 Party wall - Ground floor	9.1400	0.0800	0.7312
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139
E12 Gable (insulation at ceiling level)	9.1400	0.0770	0.7038
P4 Party wall - Roof (insulation at ceiling level)	9.1400	0.0410	0.3747

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7788 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	47.5288 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.6973	40.4538	40.2152	39.0942	38.8845	37.9082	37.9082	37.7274	38.2843	38.8845	39.3088	39.7523	(38)
Heat transfer coeff	88.2261	87.9827	87.7440	86.6231	86.4133	85.4370	85.4370	85.2562	85.8131	86.4133	86.8376	87.2812	(39)
Average = Sum(39)m / 12 =												86.6221	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0571	1.0542	1.0513	1.0379	1.0354	1.0237	1.0237	1.0215	1.0282	1.0354	1.0405	1.0458	(40)
HLP (average)												1.0379	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.5252 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

28.7461	28.3192	27.7180	26.6095	25.7795	24.8591	24.3620	24.9589	25.6089	26.5938	27.7251	28.6489	(42b)

Hot water usage for other uses

40.4910	39.0186	37.5462	36.0738	34.6014	33.1290	33.1290	34.6014	36.0738	37.5462	39.0186	40.4910	(42c)

Average daily hot water use (litres/day)	63.4621 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	69.2371	67.3378	65.2642	62.6833	60.3808	57.9881	57.4909	59.5603	61.6827	64.1400	66.7437	69.1399	(44)
Energy conte	109.6546	95.8881	100.3086	85.8103	81.2842	71.3031	69.5303	73.7481	76.0610	87.0373	95.0886	108.2564	(45)

Energy content (annual)	Total = Sum(45)m = 1053.9706

Distribution loss (46)m = 0.15 x (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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 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

93.2064	81.5049	85.2623	72.9387	69.0916	60.6076	59.1008	62.6859	64.6518	73.9817	80.8253	92.0179	(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

	93.2064	81.5049	85.2623	72.9387	69.0916	60.6076	59.1008	62.6859	64.6518	73.9817	80.8253	92.0179	(64)
									Total per year (kWh/year) = Sum(64)m =			895.8750	(64)
12Total per year (kWh/year)												896	(64)
Electric shower(s)													
	53.3032	47.4936	51.8612	49.4905	50.4192	48.0950	49.6982	50.4192	49.4905	51.8612	50.8860	53.3032	(64a)
								Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =				606.3213	(64a)
Heat gains from water heating, kWh/month													
	36.6274	32.2496	34.2809	30.6073	29.8777	27.1757	27.1997	28.2763	28.5356	31.4607	32.9278	36.3303	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	117.7004	130.3112	117.7004	121.6238	117.7004	121.6238	117.7004	117.7004	121.6238	117.7004	121.6238	117.7004	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	226.5197	228.8702	222.9469	210.3368	194.4188	179.4581	169.4635	167.1129	173.0363	185.6464	201.5644	216.5250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	(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)													
	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	(71)
Water heating gains (Table 5)													
	49.2304	47.9905	46.0765	42.5102	40.1582	37.7440	36.5588	38.0058	39.6328	42.2859	45.7331	48.8310	(72)
Total internal gains													
	454.3291	468.0506	447.6024	435.3493	413.1560	399.7045	384.6013	383.6977	395.1714	406.5114	429.7999	443.9351	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.1600	19.6403	0.3000	0.0000	0.7700	23.4104	(76)
South	1.8000	46.7521	0.3000	0.0000	0.7700	19.4395	(78)
West	7.3200	19.6403	0.3000	0.0000	0.7700	33.2101	(80)

Solar gains	76.0600	142.5987	222.9634	311.8679	373.7961	379.7183	362.6573	316.5542	254.5131	165.7672	93.6416	63.3595	(83)
Total gains	530.3892	610.6492	670.5658	747.2172	786.9521	779.4228	747.2586	700.2519	649.6845	572.2786	523.4415	507.2946	(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	55.1819	55.3346	55.4851	56.2031	56.3395	56.9833	56.9833	57.1041	56.7336	56.3395	56.0642	55.7793	
alpha	4.6788	4.6890	4.6990	4.7469	4.7560	4.7989	4.7989	4.8069	4.7822	4.7560	4.7376	4.7186	
util living area													
	0.9946	0.9889	0.9761	0.9328	0.8348	0.6577	0.4936	0.5443	0.7866	0.9541	0.9891	0.9956	(86)
MIT	19.5818	19.7807	20.0725	20.4713	20.7790	20.9484	20.9894	20.9834	20.8777	20.4687	19.9627	19.5552	(87)
Th 2	20.0360	20.0384	20.0408	20.0519	20.0539	20.0636	20.0636	20.0654	20.0599	20.0539	20.0497	20.0454	(88)
util rest of house													
	0.9931	0.9859	0.9692	0.9132	0.7888	0.5773	0.3932	0.4411	0.7160	0.9367	0.9855	0.9944	(89)
MIT 2	18.7441	18.9433	19.2328	19.6249	19.9016	20.0382	20.0605	20.0600	19.9901	19.6308	19.1339	18.7248	(90)
Living area fraction									fLA = Living area / (4) =			0.1757	(91)
MIT	18.8912	19.0904	19.3803	19.7735	20.0557	20.1981	20.2236	20.2222	20.1460	19.7780	19.2795	18.8707	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8912	19.0904	19.3803	19.7735	20.0557	20.1981	20.2236	20.2222	20.1460	19.7780	19.2795	18.8707	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9907	0.9818	0.9631	0.9064	0.7889	0.5895	0.4107	0.4590	0.7232	0.9304	0.9816	0.9923	(94)
Useful gains	525.4344	599.5518	645.8389	677.2753	620.8296	459.4350	306.9330	321.4045	469.8391	532.4371	513.8301	503.3957	(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													
	1287.3293	1248.5074	1130.1658	941.8992	722.0456	478.2826	309.5916	325.8641	518.8275	793.1037	1057.6354	1280.4755	(97)
Space heating kWh													
	566.8498	436.0982	360.3392	190.5292	75.3048	0.0000	0.0000	0.0000	0.0000	193.9360	391.5398	578.1474	(98a)
Space heating requirement - total per year (kWh/year)												2792.7444	
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													
	566.8498	436.0982	360.3392	190.5292	75.3048	0.0000	0.0000	0.0000	0.0000	193.9360	391.5398	578.1474	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2792.7444	
Space heating per m2											(98c) / (4) =	33.4621	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	803.1080	632.2340	647.9473	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8559	0.9180	0.8928	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	687.3473	580.3714	578.4822	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	862.8983	827.6838	775.0722	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	126.3967	184.0004	146.2630	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													

	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	31.5992	46.0001	36.5657	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling requirement 114.1650 (107)
Energy for space heating 33.4621 (99)
Energy for space cooling 1.3679 (108)
Total 34.8300 (109)
Fabric Energy Efficiency (DFEE) 34.8 (109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.7300 (1b)	x	2.3100 (2b)	=	96.3963	(1b) - (3b)
First floor	41.7300 (1c)	x	2.6900 (2c)	=	112.2537	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	208.6500	(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)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1438 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3938 (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) =	0.3347 (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													
	0.4268	0.4184	0.4100	0.3682	0.3598	0.3180	0.3180	0.3096	0.3347	0.3598	0.3766	0.3933	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

Effective ac	0.5911	0.5875	0.5841	0.5678	0.5647	0.5506	0.5506	0.5479	0.5560	0.5647	0.5709	0.5773	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			41.7300	0.1300	5.4249			(28a)
Main	91.3500	16.4300	74.9200	0.1800	13.4856			(29a)
PIJ	41.7300		41.7300	0.1100	4.5903			(30)
Total net area of external elements Aum(A, m2)			174.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.0019			(33)
Party Wall 1			45.7000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 209.9993 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0500	0.5790
E4 Jamb	26.1000	0.0500	1.3050
E5 Ground floor (normal)	18.2700	0.1600	2.9232
E6 Intermediate floor within a dwelling	18.2700	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0900	0.9000
E18 Party wall between dwellings	10.0000	0.0600	0.6000
P1 Party wall - Ground floor	9.1400	0.0800	0.7312
E10 Eaves (insulation at ceiling level)	9.1300	0.0600	0.5478
E12 Gable (insulation at ceiling level)	9.1400	0.0600	0.5484
P4 Party wall - Roof (insulation at ceiling level)	9.1400	0.1200	1.0968

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.8104	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 51.8123	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.6973	40.4538	40.2152	39.0942	38.8845	37.9082	37.9082	37.7274	38.2843	38.8845	39.3088	39.7523	(38)
Heat transfer coeff													
	92.5096	92.2662	92.0275	90.9066	90.6969	89.7205	89.7205	89.5397	90.0966	90.6969	91.1211	91.5647	(39)

Average = Sum(39)m / 12 = 90.9056

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1084	1.1055	1.1027	1.0892	1.0867	1.0750	1.0750	1.0728	1.0795	1.0867	1.0918	1.0971	(40)
HLP (average)												1.0892	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5252 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

28.7461	28.3192	27.7180	26.6095	25.7795	24.8591	24.3620	24.9589	25.6089	26.5938	27.7251	28.6489	(42b)

Hot water usage for other uses

40.4910	39.0186	37.5462	36.0738	34.6014	33.1290	33.1290	34.6014	36.0738	37.5462	39.0186	40.4910	(42c)

Average daily hot water use (litres/day) 63.4621 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	69.2371	67.3378	65.2642	62.6833	60.3808	57.9881	57.4909	59.5603	61.6827	64.1400	66.7437	69.1399	(44)
Energy conte	109.6546	95.8881	100.3086	85.8103	81.2842	71.3031	69.5303	73.7481	76.0610	87.0373	95.0886	108.2564	(45)
Energy content (annual)											Total = Sum(45)m =	1053.9706	
Distribution loss (46)m = 0.15 x (45)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	(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	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													
	93.2064	81.5049	85.2623	72.9387	69.0916	60.6076	59.1008	62.6859	64.6518	73.9817	80.8253	92.0179	(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													
	93.2064	81.5049	85.2623	72.9387	69.0916	60.6076	59.1008	62.6859	64.6518	73.9817	80.8253	92.0179	(64)
										Total per year (kWh/year) = Sum(64)m =		895.8750	(64)
12Total per year (kWh/year)												896	(64)
Electric shower(s)													
	53.3032	47.4936	51.8612	49.4905	50.4192	48.0950	49.6982	50.4192	49.4905	51.8612	50.8860	53.3032	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	606.3213	(64a)
Heat gains from water heating, kWh/month													
	36.6274	32.2496	34.2809	30.6073	29.8777	27.1757	27.1997	28.2763	28.5356	31.4607	32.9278	36.3303	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	126.2621	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	117.7004	130.3112	117.7004	121.6238	117.7004	121.6238	117.7004	117.7004	121.6238	117.7004	121.6238	117.7004	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	226.5197	228.8702	222.9469	210.3368	194.4188	179.4581	169.4635	167.1129	173.0363	185.6464	201.5644	216.5250	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	35.6262	(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)													
	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	(71)
Water heating gains (Table 5)													
	49.2304	47.9905	46.0765	42.5102	40.1582	37.7440	36.5588	38.0058	39.6328	42.2859	45.7331	48.8310	(72)
Total internal gains													
	454.3291	468.0506	447.6024	435.3493	413.1560	399.7045	384.6013	383.6977	395.1714	406.5114	429.7999	443.9351	(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	
East	5.1600	19.6403	0.6300	0.7000	0.7700	30.9720	(76)
South	1.8000	46.7521	0.6300	0.7000	0.7700	25.7185	(78)
West	7.3200	19.6403	0.6300	0.7000	0.7700	43.9370	(80)

Solar gains	100.6274	188.6580	294.9806	412.6012	494.5322	502.3673	479.7956	418.8013	336.7208	219.3101	123.8878	83.8246	(83)
Total gains	554.9565	656.7086	742.5830	847.9505	907.6883	902.0718	864.3970	802.4990	731.8922	625.8214	553.6877	527.7597	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.6268	52.7656	52.9025	53.5548	53.6786	54.2627	54.2627	54.3723	54.0363	53.6786	53.4287	53.1699	
alpha	4.5085	4.5177	4.5268	4.5703	4.5786	4.6175	4.6175	4.6248	4.6024	4.5786	4.5619	4.5447	
util living area													
	0.9936	0.9859	0.9675	0.9089	0.7894	0.6053	0.4500	0.5015	0.7487	0.9428	0.9870	0.9949	(86)
MIT	19.5264	19.7562	20.0853	20.5096	20.8108	20.9580	20.9913	20.9860	20.8900	20.4736	19.9281	19.4936	(87)
Th 2	19.9940	19.9963	19.9987	20.0096	20.0117	20.0213	20.0213	20.0231	20.0176	20.0117	20.0075	20.0032	(88)
util rest of house													
	0.9919	0.9820	0.9584	0.8841	0.7373	0.5244	0.3532	0.4006	0.6730	0.9217	0.9827	0.9935	(89)
MIT 2	18.6570	18.8862	19.2108	19.6220	19.8856	20.0013	20.0188	20.0187	19.9571	19.5993	19.0668	18.6313	(90)
Living area fraction										fLA = Living area / (4) =		0.1757	(91)
MIT	18.8097	19.0390	19.3644	19.7779	20.0481	20.1694	20.1896	20.1886	20.1209	19.7529	19.2181	18.7828	(92)

Temperature adjustment												0.0000	
adjusted MIT	18.8097	19.0390	19.3644	19.7779	20.0481	20.1694	20.1896	20.1886	20.1209	19.7529	19.2181	18.7828	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9890	0.9771	0.9512	0.8773	0.7394	0.5372	0.3701	0.4181	0.6817	0.9149	0.9781	0.9910	(94)
Useful gains	548.8393	641.6891	706.3166	743.9238	671.1294	484.5682	319.9383	335.5478	498.9667	572.5588	541.5866	523.0342	(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													
	1342.2847	1304.5534	1183.8770	988.8742	757.1484	499.6874	322.0632	339.2279	542.4664	830.1363	1104.2131	1335.2683	(97)
Space heating kWh													
	590.3234	445.4448	355.3049	176.3643	63.9982	0.0000	0.0000	0.0000	0.0000	191.6377	405.0911	604.3021	(98a)
Space heating requirement - total per year (kWh/year)												2832.4665	
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													
	590.3234	445.4448	355.3049	176.3643	63.9982	0.0000	0.0000	0.0000	0.0000	191.6377	405.0911	604.3021	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2832.4665	
Space heating per m2											(98c) / (4) =	33.9380	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	843.3731	663.9320	680.5021	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8862	0.9367	0.9140	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	747.3615	621.8954	621.9743	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1006.2543	964.5987	894.5817	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	186.4028	254.9712	202.8199	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	46.6007	63.7428	50.7050	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												161.0485	(107)
Energy for space heating												33.9380	(99)
Energy for space cooling												1.9296	(108)
Total												35.8677	(109)
Fabric Energy Efficiency (TFEE)												35.9	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.7300 (1b)	x	2.3100 (2b)	=	96.3963	(1b) - (3b)
First floor	41.7300 (1c)	x	2.6900 (2c)	=	112.2537	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	208.6500	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour	
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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													
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			41.7300	0.1100	4.5903	75.0000	3129.7500	(28a)
Main	91.3500	16.4300	74.9200	0.1800	13.4856	110.0000	8241.1999	(29a)
PIJ	41.7300		41.7300	0.1000	4.1730	9.0000	375.5700	(30)
Total net area of external elements Aum(A, m2)			174.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.7500			(33)
Party Wall 1			45.7000	0.0000	0.0000	70.0000	3199.0000	(32)
Internal Wall 1			161.5900			9.0000	1454.3100	(32c)
Internal Floor 1			41.7300			18.0000	751.1400	(32d)
Internal Ceiling 1			41.7300			9.0000	375.5700	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17526.5399 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 209.9993 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0200	0.2316
E4 Jamb	26.1000	0.0160	0.4176
E5 Ground floor (normal)	18.2700	0.1000	1.8270
E6 Intermediate floor within a dwelling	18.2700	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0510	0.5100
E18 Party wall between dwellings	10.0000	0.0290	0.2900
P1 Party wall - Ground floor	9.1400	0.0800	0.7312
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139
E12 Gable (insulation at ceiling level)	9.1400	0.0770	0.7038
P4 Party wall - Roof (insulation at ceiling level)	9.1400	0.0410	0.3747

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.7788 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 47.5288 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.8689	35.5031	35.1373	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	(38)
Heat transfer coeff	83.3977	83.0319	82.6661	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	(39)
Average = Sum(39)m / 12 =												82.2250	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9993	0.9949	0.9905	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	(40)
HLP (average)												0.9852	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5252 (42)
Hot water usage for mixer showers

66.5597	65.5595	64.1019	61.3131	59.2550	56.9598	55.6553	57.1018	58.6875	61.1518	64.0005	66.3047	(42a)

Hot water usage for baths

28.7461	28.3192	27.7180	26.6095	25.7795	24.8591	24.3620	24.9589	25.6089	26.5938	27.7251	28.6489	(42b)

Hot water usage for other uses

40.4910	39.0186	37.5462	36.0738	34.6014	33.1290	33.1290	34.6014	36.0738	37.5462	39.0186	40.4910	(42c)

Average daily hot water use (litres/day) 124.8280 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	135.7968	132.8972	129.3660	123.9963	119.6358	114.9479	113.1462	116.6622	120.3703	125.2918	130.7442	135.4446	(44)
Energy conte	215.0689	189.2439	198.8308	169.7448	161.0528	141.3419	136.8406	144.4521	148.4286	170.0197	186.2691	212.0735	(45)
Energy content (annual)										Total = Sum(45)m =		2073.3666	
Distribution loss (46)m = 0.15 x (45)m	32.2603	28.3866	29.8246	25.4617	24.1579	21.2013	20.5261	21.6678	22.2643	25.5030	27.9404	31.8110	(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	14.8621	13.4088	14.8134	14.2675	14.7001	14.1823	14.6274	14.6503	14.2036	14.7270	14.3171	14.8531	(61)
Total heat required for water heating calculated for each month	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(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	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
										Total per year (kWh/year) = Sum(64)m =		2246.9794	(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	75.2259	66.2758	69.8146	60.0070	57.2251	50.5418	49.1563	51.6929	52.9034	60.2133	65.5137	74.2277	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.3161	29.5910	24.0651	18.2188	13.6188	11.4975	12.4235	16.1485	21.6745	27.5208	32.1208	34.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	338.0891	341.5974	332.7566	313.9355	290.1773	267.8479	252.9306	249.4222	258.2631	277.0841	300.8423	323.1717	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	(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)													
	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	(71)
Water heating gains (Table 5)													
	101.1101	98.6247	93.8368	83.3431	76.9154	70.1969	66.0704	69.4797	73.4769	80.9319	90.9913	99.7684	(72)
Total internal gains													
	578.6968	575.9946	556.8399	521.6789	486.8930	452.7239	434.6059	438.2320	456.5960	491.7183	530.1360	563.3637	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.1600	19.6403	0.3000	0.0000	0.7700	23.4104	(76)
South	1.8000	46.7521	0.3000	0.0000	0.7700	19.4395	(78)
West	7.3200	19.6403	0.3000	0.0000	0.7700	33.2101	(80)

Solar gains	76.0600	142.5987	222.9634	311.8679	373.7961	379.7183	362.6573	316.5542	254.5131	165.7672	93.6416	63.3595	(83)
Total gains	654.7568	718.5933	779.8034	833.5468	860.6891	832.4421	797.2632	754.7862	711.1091	657.4855	623.7775	626.7232	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.3767	58.6339	58.8933	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	
alpha	4.8918	4.9089	4.9262	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	
util living area													
	0.9866	0.9775	0.9544	0.8955	0.7779	0.6049	0.4474	0.4914	0.7251	0.9199	0.9765	0.9889	(86)
MIT	19.8664	20.0360	20.3088	20.6264	20.8589	20.9681	20.9941	20.9907	20.9240	20.6228	20.1923	19.8464	(87)
Th 2	20.0840	20.0876	20.0913	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	(88)
util rest of house													
	0.9832	0.9718	0.9428	0.8696	0.7279	0.5292	0.3582	0.3990	0.6529	0.8940	0.9696	0.9861	(89)
MIT 2	19.0629	19.2325	19.5006	19.8044	20.0042	20.0830	20.0966	20.0954	20.0567	19.8079	19.3967	19.0546	(90)
Living area fraction										fLA = Living area / (4) =		0.1757	(91)
MIT	19.2040	19.3736	19.6426	19.9488	20.1543	20.2384	20.2543	20.2526	20.2090	19.9510	19.5365	19.1937	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0540	19.2236	19.4926	19.7988	20.0043	20.0884	20.1043	20.1026	20.0590	19.8010	19.3865	19.0437	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9781	0.9648	0.9334	0.8596	0.7222	0.5283	0.3588	0.3994	0.6494	0.8837	0.9625	0.9816	(94)
Useful gains	640.4145	693.3287	727.8868	716.5409	621.5871	439.7955	286.0320	301.4682	461.8272	581.0482	600.3591	615.1807	(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													
	1230.4530	1189.3182	1074.0470	893.2216	680.5899	449.8114	287.1954	303.4531	488.3799	754.0801	1006.9501	1216.5304	(97)
Space heating kWh													
	438.9887	333.3049	257.5432	127.2101	43.8981	0.0000	0.0000	0.0000	0.0000	128.7357	292.7455	447.4042	(98a)
Space heating requirement - total per year (kWh/year)												2069.8304	
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													
	438.9887	333.3049	257.5432	127.2101	43.8981	0.0000	0.0000	0.0000	0.0000	128.7357	292.7455	447.4042	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2069.8304	
Space heating per m2											(98c) / (4) =	24.8003	(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 %)												89.0000	(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													
	438.9887	333.3049	257.5432	127.2101	43.8981	0.0000	0.0000	0.0000	0.0000	128.7357	292.7455	447.4042	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	493.2457	374.4999	289.3744	142.9327	49.3237	0.0000	0.0000	0.0000	0.0000	144.6469	328.9275	502.7013	(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													
	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4082	88.3495	88.2211	87.9870	87.6345	87.3000	87.3000	87.3000	87.3000	87.9902	88.3009	88.4206	(217)
Fuel for water heating, kWh/month													
	260.0788	229.3762	242.1691	209.1359	200.5521	178.1491	173.5028	182.2479	186.2911	209.9628	227.1622	256.6446	(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	10.6920	9.6572	10.6920	10.3471	10.6920	10.3471	10.6920	10.6920	10.3471	10.6920	10.3471	10.6920	(231)
Lighting	29.1614	23.3943	21.0640	15.4324	11.9204	9.7391	10.8742	14.1347	18.3596	24.0888	27.2082	29.9719	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.4563	-41.5010	-66.6692	-81.4430	-91.5103	-86.5645	-85.1516	-78.3352	-66.0689	-50.0733	-30.2342	-22.1981	(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	-11.0765	-27.0362	-64.4430	-113.0057	-163.4091	-169.6998	-165.3718	-131.0455	-84.5531	-41.5782	-15.4812	-8.3861	(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	2325.6522	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.3000	
Water heating fuel used	2555.2727	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)		
mechanical ventilation fans (SFP = 0.1567)	39.8891	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	125.8891	(231)
Electricity for lighting (calculated in Appendix L)	235.3489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1721.2916	(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	3520.8713	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2325.6522	3.6400	84.6537	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2555.2727	3.6400	93.0119	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	125.8891	16.4900	20.7591	(249)
Energy for lighting	235.3489	16.4900	38.8090	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-726.2055	16.4900	-119.7513	
PV Unit electricity exported	-995.0861	5.5900	-55.6253	
Total			-175.3766	(252)
Total energy cost			153.8572	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4312	(257)
SAP value		93.0107	
SAP rating (Section 12)		93	(258)
SAP band		A	

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	2325.6522	0.2100	488.3870	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2555.2727	0.2100	536.6073	(264)
Space and water heating			1024.9942	(265)
Pumps, fans and electric keep-hot	125.8891	0.1387	17.4624	(267)
Energy for lighting	235.3489	0.1443	33.9681	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-726.2055	0.1329	-96.5458	
PV Unit electricity exported	-995.0861	0.1223	-121.6517	
Total			-218.1974	(269)
Total CO2, kg/year			858.2273	(272)
CO2 emissions per m2			10.2800	(273)
EI value			91.0476	
EI rating			91	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.7300 (1b)	x	2.3100 (2b)	=	96.3963	(1b) - (3b)
First floor	41.7300 (1c)	x	2.6900 (2c)	=	112.2537	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	208.6500	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			41.7300	0.1100	4.5903	75.0000	3129.7500	(28a)
Main	91.3500	16.4300	74.9200	0.1800	13.4856	110.0000	8241.1999	(29a)
PIJ	41.7300		41.7300	0.1000	4.1730	9.0000	375.5700	(30)
Total net area of external elements Aum(A, m2)			174.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.7500			(33)
Party Wall 1			45.7000	0.0000	0.0000	70.0000	3199.0000	(32)
Internal Wall 1			161.5900			9.0000	1454.3100	(32c)
Internal Floor 1			41.7300			18.0000	751.1400	(32d)
Internal Ceiling 1			41.7300			9.0000	375.5700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17526.5399	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	209.9993	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0200	0.2316
E4 Jamb	26.1000	0.0160	0.4176
E5 Ground floor (normal)	18.2700	0.1000	1.8270
E6 Intermediate floor within a dwelling	18.2700	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0510	0.5100
E18 Party wall between dwellings	10.0000	0.0290	0.2900
P1 Party wall - Ground floor	9.1400	0.0800	0.7312
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139
E12 Gable (insulation at ceiling level)	9.1400	0.0770	0.7038
P4 Party wall - Roof (insulation at ceiling level)	9.1400	0.0410	0.3747

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7788	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 47.5288	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	(38)
Heat transfer coeff	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	(39)
Average = Sum(39)m / 12 =												81.9561	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	(40)
HLP (average)												0.9820	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5252	(42)

Hot water usage for mixer showers

66.5597	65.5595	64.1019	61.3131	59.2550	56.9598	55.6553	57.1018	58.6875	61.1518	64.0005	66.3047	(42a)

Hot water usage for baths

28.7461	28.3192	27.7180	26.6095	25.7795	24.8591	24.3620	24.9589	25.6089	26.5938	27.7251	28.6489	(42b)

Hot water usage for other uses
40.4910 39.0186 37.5462 36.0738 34.6014 33.1290 33.1290 34.6014 36.0738 37.5462 39.0186 40.4910 (42c)
Average daily hot water use (litres/day) 124.8280 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	135.7968	132.8972	129.3660	123.9963	119.6358	114.9479	113.1462	116.6622	120.3703	125.2918	130.7442	135.4446	(44)
Energy conte	215.0689	189.2439	198.8308	169.7448	161.0528	141.3419	136.8406	144.4521	148.4286	170.0197	186.2691	212.0735	(45)
Energy content (annual)											Total = Sum(45)m =	2073.3666	
Distribution loss (46)m = 0.15 x (45)m	32.2603	28.3866	29.8246	25.4617	24.1579	21.2013	20.5261	21.6678	22.2643	25.5030	27.9404	31.8110	(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	14.8621	13.4088	14.8134	14.2675	14.7001	14.1823	14.6274	14.6503	14.2036	14.7270	14.3171	14.8531	(61)
Total heat required for water heating calculated for each month	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(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	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
										Total per year (kWh/year) = Sum(64)m =		2246.9794	(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	75.2259	66.2758	69.8146	60.0070	57.2251	50.5418	49.1563	51.6929	52.9034	60.2133	65.5137	74.2277	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.3161	29.5910	24.0651	18.2188	13.6188	11.4975	12.4235	16.1485	21.6745	27.5208	32.1208	34.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	338.0891	341.5974	332.7566	313.9355	290.1773	267.8479	252.9306	249.4222	258.2631	277.0841	300.8423	323.1717	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	(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)	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	(71)
Water heating gains (Table 5)	101.1101	98.6247	93.8368	83.3431	76.9154	70.1969	66.0704	69.4797	73.4769	80.9319	90.9913	99.7684	(72)
Total internal gains	578.6968	575.9946	556.8399	521.6789	486.8930	452.7239	434.6059	438.2320	456.5960	491.7183	530.1360	563.3637	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.1600	18.1295	0.3000	0.0000	0.7700	21.6096	(76)
South	1.8000	43.1558	0.3000	0.0000	0.7700	17.9442	(78)
West	7.3200	18.1295	0.3000	0.0000	0.7700	30.6555	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	70.2093	134.6765	206.7057	291.0767	358.2213	360.7323	347.3068	298.4078	241.2341	158.2324	87.9663	63.3595	(83)
Total gains	648.9061	710.6711	763.5456	812.7556	845.1143	813.4562	781.9127	736.6398	697.8301	649.9506	618.1023	626.7232	(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	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	
alpha	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	
util living area	0.9855	0.9763	0.9525	0.8929	0.7656	0.5667	0.4160	0.4511	0.7120	0.9178	0.9754	0.9880	(86)
MIT	19.9388	20.0841	20.3474	20.6447	20.8745	20.9782	20.9961	20.9943	20.9329	20.6352	20.2202	19.8830	(87)
Th 2	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	(88)
util rest of house	0.9817	0.9703	0.9402	0.8656	0.7124	0.4859	0.3239	0.3545	0.6360	0.8909	0.9679	0.9849	(89)
MIT 2	19.1461	19.2886	19.5441	19.8218	20.0169	20.0889	20.0974	20.0968	20.0630	19.8195	19.4242	19.0910	(90)
Living area fraction									fLA = Living area / (4) =			0.1757	(91)
MIT	19.2853	19.4283	19.6852	19.9664	20.1675	20.2451	20.2552	20.2545	20.2158	19.9628	19.5640	19.2301	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1353	19.2783	19.5352	19.8164	20.0175	20.0951	20.1052	20.1045	20.0658	19.8128	19.4140	19.0801	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9764	0.9632	0.9308	0.8557	0.7072	0.4856	0.3246	0.3551	0.6330	0.8807	0.9606	0.9802	(94)
Useful gains	633.5823	684.5496	710.7083	695.4450	597.6504	394.9904	253.8375	261.6103	441.7569	572.3895	593.7333	614.3230	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W	1183.0641	1153.8022	1035.5296	861.8795	648.8905	401.1837	254.4939	262.6266	464.3498	738.6546	984.6225	1194.9292	(97)
Space heating kWh	408.8145	315.3378	241.6671	119.8328	38.1227	0.0000	0.0000	0.0000	0.0000	123.7012	281.4402	431.9710	(98a)
Space heating requirement - total per year (kWh/year)												1960.8873	
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	(98b)
Solar heating contribution - total per year (kWh/year)											0.0000	
Space heating kWh												
	408.8145	315.3378	241.6671	119.8328	38.1227	0.0000	0.0000	0.0000	0.0000	123.7012	281.4402	431.9710 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)											1960.8873	
Space heating per m2										(98c) / (4) =	23.4949	(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 %)	89.0000 (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													
	408.8145	315.3378	241.6671	119.8328	38.1227	0.0000	0.0000	0.0000	0.0000	123.7012	281.4402	431.9710	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	459.3421	354.3121	271.5360	134.6436	42.8345	0.0000	0.0000	0.0000	0.0000	138.9901	316.2250	485.3607	(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													
	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.3805	88.3271	88.1941	87.9626	87.5982	87.3000	87.3000	87.3000	87.3000	87.9739	88.2846	88.4071	(217)
Fuel for water heating, kWh/month													
	260.1605	229.4343	242.2430	209.1937	200.6352	178.1491	173.5028	182.2479	186.2911	210.0017	227.2041	256.6838	(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	10.6920	9.6572	10.6920	10.3471	10.6920	10.3471	10.6920	10.6920	10.3471	10.6920	10.3471	10.6920	(231)
Lighting	29.1614	23.3943	21.0640	15.4324	11.9204	9.7391	10.8742	14.1347	18.3596	24.0888	27.2082	29.9719	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.7659	-39.7655	-63.4148	-78.3399	-89.6517	-84.5780	-83.4937	-76.0338	-64.0313	-48.4809	-28.7735	-22.1981	(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	-9.8797	-24.9641	-58.1371	-103.1455	-154.6460	-158.8731	-156.4256	-121.3441	-78.7322	-39.0047	-14.1713	-8.3861	(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	2203.2441 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	87.3000
Water heating fuel used	2555.7472 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)	
mechanical ventilation fans (SFP = 0.1567)	39.8891 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	125.8891 (231)
Electricity for lighting (calculated in Appendix L)	235.3489 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1631.2365 (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	3488.9929 (238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2203.2441	4.8000	105.7557	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2555.7472	4.8000	122.6759	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	125.8891	21.5100	27.0788	(249)
Energy for lighting	235.3489	21.5100	50.6236	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-703.5270	21.5100	-151.3287	
PV Unit electricity exported	-927.7095	5.5900	-51.8590	
Total			-203.1876	(252)
Total energy cost			200.9463	(255)

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	2203.2441	0.2100	462.6813	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2555.7472	0.2100	536.7069	(264)
Space and water heating			999.3882	(265)
Pumps, fans and electric keep-hot	125.8891	0.1387	17.4624	(267)
Energy for lighting	235.3489	0.1443	33.9681	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-703.5270	0.1328	-93.4397	
PV Unit electricity exported	-927.7095	0.1220	-113.1911	
Total			-206.6308	(269)
Total CO2, kg/year			844.1879	(272)

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	2203.2441	1.1300	2489.6659	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2555.7472	1.1300	2887.9943	(278)
Space and water heating			5377.6602	(279)
Pumps, fans and electric keep-hot	125.8891	1.5128	190.4451	(281)
Energy for lighting	235.3489	1.5338	360.9861	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-703.5270	1.4908	-1048.7980	
PV Unit electricity exported	-927.7095	0.4477	-415.3063	
Total			-1464.1043	(283)
Total Primary energy kWh/year			4464.9870	(286)

SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating: A 93
Current environmental impact rating: B 91

N	Solar water heating	SAP increase too small
U	Solar photovoltaic panels	Already installed
V2	Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
(none)			
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.6	-£ 15	-123 kg (14.6%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: A 93
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, East Pennines):

	Current	Potential	Saving
Electricity	£78	£78	£0
Mains gas	£326	£326	£0
Space heating	£231	£231	£0
Water heating	£123	£123	£0
Lighting	£51	£51	£0
Generated (PV)	-£203	-£203	£0
Total cost of fuels	£201	£201	£0
Total cost of uses	£202	£202	£0
Delivered energy	42 kWh/m²	42 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes
CO2 emissions per m²	10 kg/m²	10 kg/m²	0 kg/m²
Primary energy	53 kWh/m²	53 kWh/m²	0 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.7300 (1b)	x	2.3100 (2b)	=	96.3963 (1b) - (3b)	
First floor	41.7300 (1c)	x	2.6900 (2c)	=	112.2537 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.4600					(4)

Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 208.6500 (5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			41.7300	0.1100	4.5903	75.0000	3129.7500	(28a)
Main	91.3500	16.4300	74.9200	0.1800	13.4856	110.0000	8241.1999	(29a)
PIJ	41.7300		41.7300	0.1000	4.1730	9.0000	375.5700	(30)
Total net area of external elements Aum(A, m2)			174.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.7500			(33)
Party Wall 1			45.7000	0.0000	0.0000	70.0000	3199.0000	(32)
Internal Wall 1			161.5900			9.0000	1454.3100	(32c)
Internal Floor 1			41.7300			18.0000	751.1400	(32d)
Internal Ceiling 1			41.7300			9.0000	375.5700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17526.5399 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		209.9993 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0200	0.2316
E4 Jamb	26.1000	0.0160	0.4176
E5 Ground floor (normal)	18.2700	0.1000	1.8270
E6 Intermediate floor within a dwelling	18.2700	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0510	0.5100
E18 Party wall between dwellings	10.0000	0.0290	0.2900
P1 Party wall - Ground floor	9.1400	0.0800	0.7312
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139
E12 Gable (insulation at ceiling level)	9.1400	0.0770	0.7038
P4 Party wall - Roof (insulation at ceiling level)	9.1400	0.0410	0.3747

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7788 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	47.5288 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	35.8689	35.5031	35.1373	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	(38)
Heat transfer coeff	83.3977	83.0319	82.6661	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	(39)
Average = Sum(39)m / 12 =												82.2250	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9993	0.9949	0.9905	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	(40)
HLP (average)												0.9852	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5252	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
66.5597	65.5595	64.1019	61.3131	59.2550	56.9598	55.6553	57.1018	58.6875	61.1518	64.0005	66.3047	(42a)

Hot water usage for baths

28.7461	28.3192	27.7180	26.6095	25.7795	24.8591	24.3620	24.9589	25.6089	26.5938	27.7251	28.6489	(42b)

Hot water usage for other uses

40.4910	39.0186	37.5462	36.0738	34.6014	33.1290	33.1290	34.6014	36.0738	37.5462	39.0186	40.4910	(42c)

Average daily hot water use (litres/day)	124.8280 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	135.7968	132.8972	129.3660	123.9963	119.6358	114.9479	113.1462	116.6622	120.3703	125.2918	130.7442	135.4446	(44)

Energy conte	215.0689	189.2439	198.8308	169.7448	161.0528	141.3419	136.8406	144.4521	148.4286	170.0197	186.2691	212.0735	(45)
Energy content (annual)										Total = Sum(45)m =		2073.3666	
Distribution loss (46)m = 0.15 x (45)m													
	32.2603	28.3866	29.8246	25.4617	24.1579	21.2013	20.5261	21.6678	22.2643	25.5030	27.9404	31.8110	(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	14.8621	13.4088	14.8134	14.2675	14.7001	14.1823	14.6274	14.6503	14.2036	14.7270	14.3171	14.8531	(61)
Total heat required for water heating calculated for each month													
	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(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													
	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
										Total per year (kWh/year) = Sum(64)m =		2246.9794	(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													
	75.2259	66.2758	69.8146	60.0070	57.2251	50.5418	49.1563	51.6929	52.9034	60.2133	65.5137	74.2277	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.3161	29.5910	24.0651	18.2188	13.6188	11.4975	12.4235	16.1485	21.6745	27.5208	32.1208	34.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	338.0891	341.5974	332.7566	313.9355	290.1773	267.8479	252.9306	249.4222	258.2631	277.0841	300.8423	323.1717	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	(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)													
	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	(71)
Water heating gains (Table 5)													
	101.1101	98.6247	93.8368	83.3431	76.9154	70.1969	66.0704	69.4797	73.4769	80.9319	90.9913	99.7684	(72)
Total internal gains													
	578.6968	575.9946	556.8399	521.6789	486.8930	452.7239	434.6059	438.2320	456.5960	491.7183	530.1360	563.3637	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.1600	19.6403	0.3000	0.0000	0.7700	23.4104	(76)
South	1.8000	46.7521	0.3000	0.0000	0.7700	19.4395	(78)
West	7.3200	19.6403	0.3000	0.0000	0.7700	33.2101	(80)

Solar gains	76.0600	142.5987	222.9634	311.8679	373.7961	379.7183	362.6573	316.5542	254.5131	165.7672	93.6416	63.3595	(83)
Total gains	654.7568	718.5933	779.8034	833.5468	860.6891	832.4421	797.2632	754.7862	711.1091	657.4855	623.7775	626.7232	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.3767	58.6339	58.8933	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	
alpha	4.8918	4.9089	4.9262	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	
util living area													
	0.9866	0.9775	0.9544	0.8955	0.7779	0.6049	0.4474	0.4914	0.7251	0.9199	0.9765	0.9889	(86)
MIT	19.8664	20.0360	20.3088	20.6264	20.8589	20.9681	20.9941	20.9907	20.9240	20.6228	20.1923	19.8464	(87)
Th 2	20.0840	20.0876	20.0913	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	(88)
util rest of house													
	0.9832	0.9718	0.9428	0.8696	0.7279	0.5292	0.3582	0.3990	0.6529	0.8940	0.9696	0.9861	(89)
MIT 2	19.0629	19.2325	19.5006	19.8044	20.0042	20.0830	20.0966	20.0954	20.0567	19.8079	19.3967	19.0546	(90)
Living area fraction										fLA = Living area / (4) =		0.1757	(91)
MIT	19.2040	19.3736	19.6426	19.9488	20.1543	20.2384	20.2543	20.2526	20.2090	19.9510	19.5365	19.1937	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0540	19.2236	19.4926	19.7988	20.0043	20.0884	20.1043	20.1026	20.0590	19.8010	19.3865	19.0437	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9781	0.9648	0.9334	0.8596	0.7222	0.5283	0.3588	0.3994	0.6494	0.8837	0.9625	0.9816	(94)
Useful gains	640.4145	693.3287	727.8868	716.5409	621.5871	439.7955	286.0320	301.4682	461.8272	581.0482	600.3591	615.1807	(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													
	1230.4530	1189.3182	1074.0470	893.2216	680.5899	449.8114	287.1954	303.4531	488.3799	754.0801	1006.9501	1216.5304	(97)
Space heating kWh													
	438.9887	333.3049	257.5432	127.2101	43.8981	0.0000	0.0000	0.0000	0.0000	128.7357	292.7455	447.4042	(98a)
Space heating requirement - total per year (kWh/year)												2069.8304	
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													
	438.9887	333.3049	257.5432	127.2101	43.8981	0.0000	0.0000	0.0000	0.0000	128.7357	292.7455	447.4042	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2069.8304	
Space heating per m2											(98c) / (4) =	24.8003	(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 %)												89.0000	(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													
	438.9887	333.3049	257.5432	127.2101	43.8981	0.0000	0.0000	0.0000	0.0000	128.7357	292.7455	447.4042	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	493.2457	374.4999	289.3744	142.9327	49.3237	0.0000	0.0000	0.0000	0.0000	144.6469	328.9275	502.7013	(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													
	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4082	88.3495	88.2211	87.9870	87.6345	87.3000	87.3000	87.3000	87.3000	87.9902	88.3009	88.4206	(217)
Fuel for water heating, kWh/month													
	260.0788	229.3762	242.1691	209.1359	200.5521	178.1491	173.5028	182.2479	186.2911	209.9628	227.1622	256.6446	(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	10.6920	9.6572	10.6920	10.3471	10.6920	10.3471	10.6920	10.6920	10.3471	10.6920	10.3471	10.6920	(231)
Lighting	29.1614	23.3943	21.0640	15.4324	11.9204	9.7391	10.8742	14.1347	18.3596	24.0888	27.2082	29.9719	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.4563	-41.5010	-66.6692	-81.4430	-91.5103	-86.5645	-85.1516	-78.3352	-66.0689	-50.0733	-30.2342	-22.1981	(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	-11.0765	-27.0362	-64.4430	-113.0057	-163.4091	-169.6998	-165.3718	-131.0455	-84.5531	-41.5782	-15.4812	-8.3861	(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												2325.6522	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2555.2727	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)													
mechanical ventilation fans (SFP = 0.1567)												39.8891	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												125.8891	(231)
Electricity for lighting (calculated in Appendix L)												235.3489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1721.2916	(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												3520.8713	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2325.6522	3.6400	84.6537	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2555.2727	3.6400	93.0119	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	125.8891	16.4900	20.7591	(249)
Energy for lighting	235.3489	16.4900	38.8090	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-726.2055	16.4900	-119.7513	
PV Unit electricity exported	-995.0861	5.5900	-55.6253	
Total			-175.3766	(252)
Total energy cost			153.8572	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4312	(257)
SAP value		93.0107	
SAP rating (Section 12)		93	(258)
SAP band		A	

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	2325.6522	0.2100	488.3870	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2555.2727	0.2100	536.6073	(264)
Space and water heating			1024.9942	(265)
Pumps, fans and electric keep-hot	125.8891	0.1387	17.4624	(267)
Energy for lighting	235.3489	0.1443	33.9681	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-726.2055	0.1329	-96.5458	
PV Unit electricity exported	-995.0861	0.1223	-121.6517	
Total			-218.1974	(269)
Total CO2, kg/year			858.2273	(272)
CO2 emissions per m2			10.2800	(273)
EI value			91.0476	
EI rating			91	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.7300	(1b)	x 2.3100	(2b) =	96.3963	(1b) - (3b)
First floor	41.7300	(1c)	x 2.6900	(2c) =	112.2537	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		208.6500	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)
Mechanical extract ventilation - decentralised													
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)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			41.7300	0.1100	4.5903	75.0000	3129.7500	(28a)
Main	91.3500	16.4300	74.9200	0.1800	13.4856	110.0000	8241.1999	(29a)
PIJ	41.7300		41.7300	0.1000	4.1730	9.0000	375.5700	(30)
Total net area of external elements Aum(A, m2)			174.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.7500			(33)
Party Wall 1			45.7000	0.0000	0.0000	70.0000	3199.0000	(32)
Internal Wall 1			161.5900			9.0000	1454.3100	(32c)
Internal Floor 1			41.7300			18.0000	751.1400	(32d)
Internal Ceiling 1			41.7300			9.0000	375.5700	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17526.5399	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							209.9993	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790	
E3 Sill	11.5800	0.0200	0.2316	
E4 Jamb	26.1000	0.0160	0.4176	
E5 Ground floor (normal)	18.2700	0.1000	1.8270	
E6 Intermediate floor within a dwelling	18.2700	0.0000	0.0000	
E16 Corner (normal)	10.0000	0.0510	0.5100	
E18 Party wall between dwellings	10.0000	0.0290	0.2900	
P1 Party wall - Ground floor	9.1400	0.0800	0.7312	
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139	
E12 Gable (insulation at ceiling level)	9.1400	0.0770	0.7038	
P4 Party wall - Roof (insulation at ceiling level)	9.1400	0.0410	0.3747	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.7788 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 47.5288 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	34.4272	(38)
Heat transfer coeff	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	81.9561	(39)
Average = Sum(39)m / 12 =												81.9561	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	0.9820	(40)
HLP (average)												0.9820	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5252 (42)

Hot water usage for mixer showers

66.5597	65.5595	64.1019	61.3131	59.2550	56.9598	55.6553	57.1018	58.6875	61.1518	64.0005	66.3047	(42a)

Hot water usage for baths

28.7461	28.3192	27.7180	26.6095	25.7795	24.8591	24.3620	24.9589	25.6089	26.5938	27.7251	28.6489	(42b)

Hot water usage for other uses

40.4910	39.0186	37.5462	36.0738	34.6014	33.1290	33.1290	34.6014	36.0738	37.5462	39.0186	40.4910	(42c)

Average daily hot water use (litres/day) 124.8280 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	135.7968	132.8972	129.3660	123.9963	119.6358	114.9479	113.1462	116.6622	120.3703	125.2918	130.7442	135.4446	(44)
Energy conte	215.0689	189.2439	198.8308	169.7448	161.0528	141.3419	136.8406	144.4521	148.4286	170.0197	186.2691	212.0735	(45)
Energy content (annual)										Total = Sum(45)m =		2073.3666	
Distribution loss (46)m = 0.15 x (45)m	32.2603	28.3866	29.8246	25.4617	24.1579	21.2013	20.5261	21.6678	22.2643	25.5030	27.9404	31.8110	(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	14.8621	13.4088	14.8134	14.2675	14.7001	14.1823	14.6274	14.6503	14.2036	14.7270	14.3171	14.8531	(61)
Total heat required for water heating calculated for each month	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(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	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
									Total per year (kWh/year) = Sum(64)m =			2246.9794	(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	75.2259	66.2758	69.8146	60.0070	57.2251	50.5418	49.1563	51.6929	52.9034	60.2133	65.5137	74.2277	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	151.5145	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.3161	29.5910	24.0651	18.2188	13.6188	11.4975	12.4235	16.1485	21.6745	27.5208	32.1208	34.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	338.0891	341.5974	332.7566	313.9355	290.1773	267.8479	252.9306	249.4222	258.2631	277.0841	300.8423	323.1717	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	52.6767	(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)	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	-101.0096	(71)
Water heating gains (Table 5)	101.1101	98.6247	93.8368	83.3431	76.9154	70.1969	66.0704	69.4797	73.4769	80.9319	90.9913	99.7684	(72)
Total internal gains	578.6968	575.9946	556.8399	521.6789	486.8930	452.7239	434.6059	438.2320	456.5960	491.7183	530.1360	563.3637	(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	
East	5.1600	18.1295	0.3000	0.0000	0.7700	21.6096	(76)
South	1.8000	43.1558	0.3000	0.0000	0.7700	17.9442	(78)
West	7.3200	18.1295	0.3000	0.0000	0.7700	30.6555	(80)

Solar gains	70.2093	134.6765	206.7057	291.0767	358.2213	360.7323	347.3068	298.4078	241.2341	158.2324	87.9663	63.3595	(83)
Total gains	648.9061	710.6711	763.5456	812.7556	845.1143	813.4562	781.9127	736.6398	697.8301	649.9506	618.1023	626.7232	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	59.4036	
alpha	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	4.9602	
util living area													
	0.9855	0.9763	0.9525	0.8929	0.7656	0.5667	0.4160	0.4511	0.7120	0.9178	0.9754	0.9880	(86)
MIT	19.9388	20.0841	20.3474	20.6447	20.8745	20.9782	20.9961	20.9943	20.9329	20.6352	20.2202	19.8830	(87)
Th 2	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	20.0984	(88)
util rest of house													
	0.9817	0.9703	0.9402	0.8656	0.7124	0.4859	0.3239	0.3545	0.6360	0.8909	0.9679	0.9849	(89)
MIT 2	19.1461	19.2886	19.5441	19.8218	20.0169	20.0889	20.0974	20.0968	20.0630	19.8195	19.4242	19.0910	(90)
Living area fraction										fLA = Living area / (4) =		0.1757	(91)
MIT	19.2853	19.4283	19.6852	19.9664	20.1675	20.2451	20.2552	20.2545	20.2158	19.9628	19.5640	19.2301	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1353	19.2783	19.5352	19.8164	20.0175	20.0951	20.1052	20.1045	20.0658	19.8128	19.4140	19.0801	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9764	0.9632	0.9308	0.8557	0.7072	0.4856	0.3246	0.3551	0.6330	0.8807	0.9606	0.9802	(94)
Useful gains	633.5823	684.5496	710.7083	695.4450	597.6504	394.9904	253.8375	261.6103	441.7569	572.3895	593.7333	614.3230	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W													
	1183.0641	1153.8022	1035.5296	861.8795	648.8905	401.1837	254.4939	262.6266	464.3498	738.6546	984.6225	1194.9292	(97)
Space heating kWh													
	408.8145	315.3378	241.6671	119.8328	38.1227	0.0000	0.0000	0.0000	0.0000	123.7012	281.4402	431.9710	(98a)
Space heating requirement - total per year (kWh/year)												1960.8873	
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													
	408.8145	315.3378	241.6671	119.8328	38.1227	0.0000	0.0000	0.0000	0.0000	123.7012	281.4402	431.9710	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1960.8873	
Space heating per m2											(98c) / (4) =	23.4949	(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 %)												89.0000	(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													
	408.8145	315.3378	241.6671	119.8328	38.1227	0.0000	0.0000	0.0000	0.0000	123.7012	281.4402	431.9710	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	459.3421	354.3121	271.5360	134.6436	42.8345	0.0000	0.0000	0.0000	0.0000	138.9901	316.2250	485.3607	(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													
	229.9310	202.6527	213.6442	184.0123	175.7529	155.5242	151.4680	159.1024	162.6321	184.7467	200.5862	226.9266	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.3805	88.3271	88.1941	87.9626	87.5982	87.3000	87.3000	87.3000	87.3000	87.9739	88.2846	88.4071	(217)
Fuel for water heating, kWh/month													
	260.1605	229.4343	242.2430	209.1937	200.6352	178.1491	173.5028	182.2479	186.2911	210.0017	227.2041	256.6838	(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	10.6920	9.6572	10.6920	10.3471	10.6920	10.3471	10.6920	10.6920	10.3471	10.6920	10.3471	10.6920	(231)
Lighting	29.1614	23.3943	21.0640	15.4324	11.9204	9.7391	10.8742	14.1347	18.3596	24.0888	27.2082	29.9719	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.7659	-39.7655	-63.4148	-78.3399	-89.6517	-84.5780	-83.4937	-76.0338	-64.0313	-48.4809	-28.7735	-22.1981	(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	-9.8797	-24.9641	-58.1371	-103.1455	-154.6460	-158.8731	-156.4256	-121.3441	-78.7322	-39.0047	-14.1713	-8.3861	(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												2203.2441	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2555.7472	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)													
mechanical ventilation fans (SFP = 0.1567)												39.8891	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												125.8891	(231)
Electricity for lighting (calculated in Appendix L)												235.3489	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1631.2365	(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	3488.9929	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2203.2441	4.8000	105.7557	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2555.7472	4.8000	122.6759	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	125.8891	21.5100	27.0788	(249)
Energy for lighting	235.3489	21.5100	50.6236	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-703.5270	21.5100	-151.3287	
PV Unit electricity exported	-927.7095	5.5900	-51.8590	
Total			-203.1876	(252)
Total energy cost			200.9463	(255)

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	2203.2441	0.2100	462.6813	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2555.7472	0.2100	536.7069	(264)
Space and water heating			999.3882	(265)
Pumps, fans and electric keep-hot	125.8891	0.1387	17.4624	(267)
Energy for lighting	235.3489	0.1443	33.9681	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-703.5270	0.1328	-93.4397	
PV Unit electricity exported	-927.7095	0.1220	-113.1911	
Total			-206.6308	(269)
Total CO2, kg/year			844.1879	(272)

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	2203.2441	1.1300	2489.6659	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2555.7472	1.1300	2887.9943	(278)
Space and water heating			5377.6602	(279)
Pumps, fans and electric keep-hot	125.8891	1.5128	190.4451	(281)
Energy for lighting	235.3489	1.5338	360.9861	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-703.5270	1.4908	-1048.7980	
PV Unit electricity exported	-927.7095	0.4477	-415.3063	
Total			-1464.1043	(283)
Total Primary energy kWh/year			4464.9870	(286)

Full SAP Calculation Printout

Property Reference	HL0889-Semi	**Issued on Date**	16/11/2023
Assessment Reference	001	**Prop Type Ref**	HT-HL889 (Semi)
Property	S63 0JF		

SAP Rating	93 A	**DER**	10.96	**TER**	11.29
Environmental	91 B	**% DER < TER**			2.92
CO_2 Emissions (t/year)	0.89	**DFEE**	35.41	**TFEE**	36.55
Compliance Check	See BREL	**% DFEE < TFEE**			3.14
% DPER < TPER	1.52	**DPER**	58.05	**TPER**	58.95

Assessor Details	Mr. Paul Goddard	**Assessor ID**	B342-0001
Client	Hoober Homes, Hoober Homes		

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7900 (1b)	x	2.3100 (2b)	=	101.1549	(1b) - (3b)
First floor	43.7900 (1c)	x	2.6900 (2c)	=	117.7951	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.9500	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation		(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			43.7900	0.1100	4.8169	75.0000	3284.2500	(28a)
Main	93.6000	16.4300	77.1700	0.1800	13.8906	110.0000	8488.6999	(29a)
PIJ	43.7900		43.7900	0.1000	4.3790	9.0000	394.1100	(30)
Total net area of external elements Aum(A, m2)			181.1800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.5876			(33)
Party Wall 1			47.9500	0.0000	0.0000	70.0000	3356.5000	(32)
Internal Wall 1			164.0100			9.0000	1476.0900	(32c)
Internal Floor 1			43.7900			18.0000	788.2200	(32d)
Internal Ceiling 1			43.7900			9.0000	394.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18181.9799	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	207.6042	(35)
List of Thermal Bridges		

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790	
E3 Sill	11.5800	0.0200	0.2316	
E4 Jamb	26.1000	0.0160	0.4176	
E5 Ground floor (normal)	18.7200	0.1080	2.0218	
E6 Intermediate floor within a dwelling	18.7200	0.0000	0.0000	
E16 Corner (normal)	10.0000	0.0510	0.5100	
E18 Party wall between dwellings	10.0000	0.0290	0.2900	
P1 Party wall - Ground floor	9.5900	0.0800	0.7672	
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139	
E12 Gable (insulation at ceiling level)	9.5900	0.0770	0.7384	
P4 Party wall - Roof (insulation at ceiling level)	9.5900	0.0410	0.3932	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			7.0626	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	48.6503	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.6396	37.2557	36.8719	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	(38)
Heat transfer coeff	86.2898	85.9060	85.5221	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	(39)
Average = Sum(39)m / 12 =												85.0593	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9853	0.9809	0.9765	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	(40)
HLP (average)												0.9712	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5911 (42)

Hot water usage for mixer showers

67.6644	66.6475	65.1658	62.3307	60.2384	57.9052	56.5790	58.0495	59.6615	62.1667	65.0627	67.4052	(42a)

Hot water usage for baths

29.2211	28.7872	28.1760	27.0492	26.2055	25.2699	24.7646	25.3714	26.0322	27.0333	28.1833	29.1223	(42b)

Hot water usage for other uses

41.1657	39.6688	38.1719	36.6749	35.1780	33.6810	33.6810	35.1780	36.6749	38.1719	39.6688	41.1657	(42c)

Average daily hot water use (litres/day) 126.9003 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.0513	135.1035	131.5137	126.0548	121.6219	116.8562	115.0246	118.5989	122.3686	127.3718	132.9148	137.6932	(44)
Energy conte	218.6395	192.3856	202.1316	172.5627	163.7265	143.6883	139.1123	146.8503	150.8927	172.8424	189.3615	215.5943	(45)
Energy content (annual)										Total = Sum(45)m =		2107.7876	
Distribution loss (46)m = 0.15 x (45)m	32.7959	28.8578	30.3197	25.8844	24.5590	21.5532	20.8668	22.0275	22.6339	25.9264	28.4042	32.3391	(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	14.8728	13.4182	14.8233	14.2760	14.7081	14.1894	14.6342	14.6575	14.2110	14.7354	14.3264	14.8637	(61)
Total heat required for water heating calculated for each month	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(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	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
										Total per year (kWh/year) = Sum(64)m =		2281.5036	(64)
12Total per year (kWh/year)												2282	(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	76.4158	67.3228	70.9146	60.9461	58.1161	51.3237	49.9134	52.4921	53.7246	61.1540	66.5443	75.4010	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	122.9722	136.1478	122.9722	127.0712	122.9722	127.0712	122.9722	122.9722	127.0712	122.9722	127.0712	122.9722	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.5544	236.9884	230.8549	217.7975	201.3149	185.8236	175.4744	173.0405	179.1739	192.2313	208.7139	224.2053	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	(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)	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	(71)
Water heating gains (Table 5)	102.7094	100.1827	95.3153	84.6474	78.1130	71.2829	67.0879	70.5539	74.6175	82.1962	92.4226	101.3455	(72)
Total internal gains	525.1029	538.1857	514.0093	494.3830	467.2670	446.0446	427.4014	428.4334	442.7295	462.2666	493.0747	513.3898	(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	1.8000	10.6334	0.3000	0.0000	0.7700	4.4214	(74)
East	5.1600	19.6403	0.3000	0.0000	0.7700	23.4104	(76)
West	7.3200	19.6403	0.3000	0.0000	0.7700	33.2101	(80)

Solar gains	61.0419	119.2112	196.7665	289.0945	357.0995	367.0104	348.7965	297.5737	229.4116	141.4861	76.0535	50.2478	(83)
Total gains	586.1448	657.3969	710.7758	783.4776	824.3665	813.0550	776.1979	726.0071	672.1412	603.7527	569.1282	563.6376	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5301	58.7916	59.0555	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	
alpha	4.9020	4.9194	4.9370	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	
util living area	0.9928	0.9863	0.9716	0.9227	0.8135	0.6347	0.4740	0.5256	0.7699	0.9464	0.9859	0.9940	(86)
MIT	19.7420	19.9232	20.1939	20.5548	20.8268	20.9610	20.9925	20.9876	20.9009	20.5440	20.0928	19.7301	(87)
Th 2	20.0956	20.0993	20.1030	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	(88)
util rest of house	0.9908	0.9827	0.9639	0.9018	0.7669	0.5584	0.3814	0.4294	0.7008	0.9275	0.9816	0.9924	(89)
MIT 2	18.9503	19.1325	19.4014	19.7517	19.9914	20.0908	20.1078	20.1060	20.0536	19.7481	19.3101	18.9497	(90)
Living area fraction										fLA = Living area / (4) =		0.1908	(91)
MIT	19.1013	19.2833	19.5526	19.9049	20.1508	20.2568	20.2766	20.2742	20.2152	19.9000	19.4594	19.0986	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9513	19.1333	19.4026	19.7549	20.0008	20.1068	20.1266	20.1242	20.0652	19.7500	19.3094	18.9486	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9875	0.9776	0.9562	0.8918	0.7606	0.5581	0.3831	0.4309	0.6970	0.9178	0.9763	0.9895	(94)
Useful gains	578.8047	642.6681	679.6547	698.7317	627.0007	453.7727	297.3663	312.8639	468.4655	554.1449	555.6538	557.6927	(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	1264.2613	1222.7296	1103.4571	920.2473	703.7170	466.8535	298.9728	315.7253	505.7143	775.7079	1035.0798	1250.3457	(97)
Space heating kWh	509.9797	389.8013	315.3090	159.4913	57.0769	0.0000	0.0000	0.0000	0.0000	164.8429	345.1867	515.3339	(98a)
Space heating requirement - total per year (kWh/year)												2457.0217	
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	509.9797	389.8013	315.3090	159.4913	57.0769	0.0000	0.0000	0.0000	0.0000	164.8429	345.1867	515.3339	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2457.0217	
Space heating per m2											(98c) / (4) =	28.0546	(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 %) 89.0000 (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	509.9797	389.8013	315.3090	159.4913	57.0769	0.0000	0.0000	0.0000	0.0000	164.8429	345.1867	515.3339	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	573.0109	437.9790	354.2798	179.2037	64.1314	0.0000	0.0000	0.0000	0.0000	185.2167	387.8503	579.0268	(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	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4590	88.4052	88.2991	88.0747	87.7060	87.3000	87.3000	87.3000	87.3000	88.0870	88.3615	88.4677	(217)
Fuel for water heating, kWh/month	263.9780	232.7962	245.7044	212.1366	203.4462	180.8449	176.1128	185.0031	189.1223	212.9461	230.5167	260.4997	(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	10.8592	9.8083	10.8592	10.5089	10.8592	10.5089	10.8592	10.8592	10.5089	10.8592	10.5089	10.8592	(231)
Lighting	30.7591	24.6761	22.2181	16.2779	12.5735	10.2727	11.4700	14.9091	19.3655	25.4086	28.6989	31.6140	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.6184	-41.8641	-67.4493	-82.6566	-93.0984	-88.1433	-86.6946	-79.6381	-67.0016	-50.5980	-30.4527	-22.3228	(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	-10.9144	-26.6731	-63.6629	-111.7920	-161.8210	-168.1210	-163.8288	-129.7425	-83.6205	-41.0535	-15.2628	-8.2614	(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 2760.6985 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 87.3000
Water heating fuel used 2593.1070 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)
mechanical ventilation fans (SFP = 0.1567) 41.8583 (230a)
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)

Total electricity for the above, kWh/year	127.8583	(231)
Electricity for lighting (calculated in Appendix L)	248.2436	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1721.2916	(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	4008.6158	(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	2760.6985	0.2100	579.7467	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2593.1070	0.2100	544.5525	(264)
Space and water heating			1124.2992	(265)
Pumps, fans and electric keep-hot	127.8583	0.1387	17.7355	(267)
Energy for lighting	248.2436	0.1443	35.8292	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-736.5379	0.1329	-97.8779	
PV Unit electricity exported	-984.7537	0.1222	-120.3569	
Total			-218.2348	(269)
Total CO2, kg/year			959.6291	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.9600	(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	2760.6985	1.1300	3119.5893	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2593.1070	1.1300	2930.2110	(278)
Space and water heating			6049.8003	(279)
Pumps, fans and electric keep-hot	127.8583	1.5128	193.4240	(281)
Energy for lighting	248.2436	1.5338	380.7643	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-736.5379	1.4910	-1098.2129	
PV Unit electricity exported	-984.7537	0.4485	-441.6171	
Total			-1539.8301	(283)
Total Primary energy kWh/year			5084.1585	(286)
Dwelling Primary energy Rate (DPER)			58.0500	(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		43.7900 (1b)	x	2.3100 (2b)	=	101.1549	(1b) - (3b)
First floor		43.7900 (1c)	x	2.6900 (2c)	=	117.7951	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.9500	(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)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1370	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3870	(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) =	0.3290	(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													
	0.4194	0.4112	0.4030	0.3619	0.3536	0.3125	0.3125	0.3043	0.3290	0.3536	0.3701	0.3865	(22b)
Effective ac	0.5880	0.5845	0.5812	0.5655	0.5625	0.5488	0.5488	0.5463	0.5541	0.5625	0.5685	0.5747	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			43.7900	0.1300	5.6927			(28a)
Main	93.6000	16.4300	77.1700	0.1800	13.8906			(29a)
PIJ	43.7900		43.7900	0.1100	4.8169			(30)
Total net area of external elements Aum(A, m2)			181.1800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.9013			(33)
Party Wall 1			47.9500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 207.6042 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0500	0.5790
E4 Jamb	26.1000	0.0500	1.3050
E5 Ground floor (normal)	18.7200	0.1600	2.9952
E6 Intermediate floor within a dwelling	18.7200	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0900	0.9000
E18 Party wall between dwellings	10.0000	0.0600	0.6000
P1 Party wall - Ground floor	9.5900	0.0800	0.7672
E10 Eaves (insulation at ceiling level)	9.1300	0.0600	0.5478
E12 Gable (insulation at ceiling level)	9.5900	0.0600	0.5754
P4 Party wall - Roof (insulation at ceiling level)	9.5900	0.1200	1.1508

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.9994 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 52.9007 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4822	42.2354	41.9935	40.8573	40.6447	39.6551	39.6551	39.4719	40.0363	40.6447	41.0748	41.5244	(38)
Heat transfer coeff	95.3830	95.1362	94.8943	93.7581	93.5455	92.5559	92.5559	92.3726	92.9371	93.5455	93.9755	94.4251	(39)
Average = Sum(39)m / 12 =												93.7570	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0891	1.0863	1.0835	1.0705	1.0681	1.0568	1.0568	1.0547	1.0612	1.0681	1.0730	1.0782	(40)
HLP (average)												1.0705	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5911 (42)

Hot water usage for mixer showers													
	67.6644	66.6475	65.1658	62.3307	60.2384	57.9052	56.5790	58.0495	59.6615	62.1667	65.0627	67.4052	(42a)
Hot water usage for baths													
	29.2211	28.7872	28.1760	27.0492	26.2055	25.2699	24.7646	25.3714	26.0322	27.0333	28.1833	29.1223	(42b)
Hot water usage for other uses													
	41.1657	39.6688	38.1719	36.6749	35.1780	33.6810	33.6810	35.1780	36.6749	38.1719	39.6688	41.1657	(42c)
Average daily hot water use (litres/day)												126.9003	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.0513	135.1035	131.5137	126.0548	121.6219	116.8562	115.0246	118.5989	122.3686	127.3718	132.9148	137.6932	(44)
Energy conte	218.6395	192.3856	202.1316	172.5627	163.7265	143.6883	139.1123	146.8503	150.8927	172.8424	189.3615	215.5943	(45)
Energy content (annual)										Total = Sum(45)m =		2107.7876	
Distribution loss (46)m = 0.15 x (45)m													
	32.7959	28.8578	30.3197	25.8844	24.5590	21.5532	20.8668	22.0275	22.6339	25.9264	28.4042	32.3391	(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	269.5984	238.4130	253.0905	221.8778	214.6854	193.0033	190.0712	197.8092	200.2078	223.8013	238.6766	266.5532	(62)
WWHRS	-30.9333	-27.3577	-28.6474	-23.7212	-22.1073	-18.9174	-17.7320	-18.8562	-19.5726	-23.0740	-26.1400	-30.3605	(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	238.6650	211.0553	224.4431	198.1566	192.5781	174.0860	172.3392	178.9529	180.6352	200.7273	212.5365	236.1927	(64)
									Total per year (kWh/year) = Sum(64)m =			2420.3679	(64)
12Total per year (kWh/year)												2420	(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	85.4373	75.4751	79.9485	69.7059	67.1788	60.1051	58.9946	61.5674	62.5006	70.2098	75.2915	84.4248	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	122.9722	136.1478	122.9722	127.0712	122.9722	127.0712	122.9722	122.9722	127.0712	122.9722	127.0712	122.9722	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.5544	236.9884	230.8549	217.7975	201.3149	185.8236	175.4744	173.0405	179.1739	192.2313	208.7139	224.2053	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	(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)													

	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	(71)
Water heating gains (Table 5)													
	114.8351	112.3141	107.4576	96.8137	90.2940	83.4793	79.2938	82.7519	86.8064	94.3680	104.5715	113.4742	(72)
Total internal gains													
	537.2286	550.3171	526.1516	506.5494	479.4480	458.2410	439.6072	440.6315	454.9185	474.4384	505.2235	525.5186	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.8000	10.6334	0.6300	0.7000	0.7700	5.8495	(74)
East	5.1600	19.6403	0.6300	0.7000	0.7700	30.9720	(76)
West	7.3200	19.6403	0.6300	0.7000	0.7700	43.9370	(80)

Solar gains	80.7584	157.7164	260.3221	382.4721	472.4426	485.5548	461.4578	393.6900	303.5116	187.1861	100.6187	66.4779	(83)
Total gains	617.9871	708.0335	786.4737	889.0215	951.8907	943.7958	901.0650	834.3215	758.4300	661.6246	605.8423	591.9965	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.9502	53.0876	53.2229	53.8679	53.9903	54.5676	54.5676	54.6758	54.3438	53.9903	53.7432	53.4873	
alpha	4.5300	4.5392	4.5482	4.5912	4.5994	4.6378	4.6378	4.6451	4.6229	4.5994	4.5829	4.5658	
util living area													
	0.9916	0.9836	0.9648	0.9051	0.7826	0.5986	0.4457	0.4982	0.7471	0.9386	0.9839	0.9930	(86)
MIT	19.5966	19.8033	20.1152	20.5258	20.8202	20.9605	20.9918	20.9866	20.8924	20.4939	19.9797	19.5670	(87)
Th 2	20.0097	20.0121	20.0143	20.0250	20.0270	20.0363	20.0363	20.0380	20.0327	20.0270	20.0229	20.0187	(88)
util rest of house													
	0.9893	0.9792	0.9552	0.8800	0.7307	0.5193	0.3511	0.3992	0.6725	0.9167	0.9789	0.9911	(89)
MIT 2	18.3799	18.6436	19.0372	19.5440	19.8730	20.0121	20.0332	20.0325	19.9562	19.5188	18.8773	18.3485	(90)
Living area fraction									fLA = Living area / (4) =			0.1908	(91)
MIT	18.6121	18.8648	19.2429	19.7313	20.0537	20.1930	20.2161	20.2145	20.1349	19.7049	19.0876	18.5810	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6121	18.8648	19.2429	19.7313	20.0537	20.1930	20.2161	20.2145	20.1349	19.7049	19.0876	18.5810	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9847	0.9723	0.9456	0.8711	0.7322	0.5327	0.3691	0.4178	0.6811	0.9077	0.9722	0.9871	(94)
Useful gains	608.5364	688.4335	743.6744	774.4369	697.0105	502.7385	332.5547	348.6174	516.5323	600.5610	588.9981	584.3811	(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													
	1365.1279	1328.5617	1209.2249	1015.5242	781.4523	517.6660	334.6919	352.3599	560.8620	851.7201	1126.5446	1357.9263	(97)
Space heating kWh													
	562.9041	430.1661	346.3696	173.5829	62.8247	0.0000	0.0000	0.0000	0.0000	186.8624	387.0335	575.5176	(98a)
Space heating requirement - total per year (kWh/year)												2725.2609	
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													
	562.9041	430.1661	346.3696	173.5829	62.8247	0.0000	0.0000	0.0000	0.0000	186.8624	387.0335	575.5176	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2725.2609	
Space heating per m2											(98c) / (4) =	31.1174	(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													
	562.9041	430.1661	346.3696	173.5829	62.8247	0.0000	0.0000	0.0000	0.0000	186.8624	387.0335	575.5176	(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)													
	609.2035	465.5478	374.8589	187.8603	67.9921	0.0000	0.0000	0.0000	0.0000	202.2320	418.8674	622.8545	(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													
	238.6650	211.0553	224.4431	198.1566	192.5781	174.0860	172.3392	178.9529	180.6352	200.7273	212.5365	236.1927	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.1527	85.8729	85.3076	84.0989	82.2574	80.3000	80.3000	80.3000	80.3000	84.2283	85.6484	86.2133	(217)
Fuel for water heating, kWh/month													
	277.0255	245.7763	263.0986	235.6234	234.1164	216.7945	214.6191	222.8555	224.9504	238.3134	248.1500	273.9633	(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	25.5512	20.4981	18.4563	13.5219	10.4447	8.5334	9.5280	12.3848	16.0867	21.1066	23.8398	26.2613	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-40.5484	-56.9481	-81.5450	-91.3166	-98.1445	-91.4737	-90.3228	-85.4161	-76.7233	-64.9267	-44.4931	-35.0804	(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	-23.5688	-49.5074	-98.2738	-147.4278	-194.7819	-195.6719	-193.3878	-163.8270	-120.1821	-70.7643	-31.4543	-18.6447	(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	2949.4165	(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	2895.2863	(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)	206.2127	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2164.4305	(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	3972.4851	(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	2949.4165	0.2100	619.3775	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2895.2863	0.2100	608.0101	(264)
Space and water heating			1227.3876	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	206.2127	0.1443	29.7629	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-856.9387	0.1347	-115.4069	
PV Unit electricity exported	-1307.4918	0.1259	-164.6502	
Total			-280.0572	(269)
Total CO2, kg/year			989.0226	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.2900	(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	2949.4165	1.1300	3332.8407	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2895.2863	1.1300	3271.6736	(278)
Space and water heating			6604.5143	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	206.2127	1.5338	316.2959	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-856.9387	1.4977	-1283.4674	
PV Unit electricity exported	-1307.4918	0.4622	-604.3812	
Total			-1887.8487	(283)
Total Primary energy kWh/year			5163.0624	(286)
Target Primary Energy Rate (TPER)			58.9500	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		43.7900 (1b)	x	2.3100 (2b)	=	101.1549	(1b) - (3b)
First floor		43.7900 (1c)	x	2.6900 (2c)	=	117.7951	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.9500	(5)

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2. Ventilation rate

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		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)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1370 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3870 (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) =	0.3290 (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	0.4194	0.4112	0.4030	0.3619	0.3536	0.3125	0.3125	0.3043	0.3290	0.3536	0.3701	0.3865	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		0.0000 (23c)

Effective ac	0.5880	0.5845	0.5812	0.5655	0.5625	0.5488	0.5488	0.5463	0.5541	0.5625	0.5685	0.5747	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			43.7900	0.1100	4.8169	75.0000	3284.2500	(28a)
Main	93.6000	16.4300	77.1700	0.1800	13.8906	110.0000	8488.6999	(29a)
PIJ	43.7900		43.7900	0.1000	4.3790	9.0000	394.1100	(30)
Total net area of external elements Aum(A, m2)			181.1800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.5876			(33)
Party Wall 1			47.9500	0.0000	0.0000	70.0000	3356.5000	(32)
Internal Wall 1			164.0100			9.0000	1476.0900	(32c)
Internal Floor 1			43.7900			18.0000	788.2200	(32d)
Internal Ceiling 1			43.7900			9.0000	394.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	18181.9799 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		207.6042 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0200	0.2316
E4 Jamb	26.1000	0.0160	0.4176
E5 Ground floor (normal)	18.7200	0.1080	2.0218
E6 Intermediate floor within a dwelling	18.7200	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0510	0.5100
E18 Party wall between dwellings	10.0000	0.0290	0.2900
P1 Party wall - Ground floor	9.5900	0.0800	0.7672
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139
E12 Gable (insulation at ceiling level)	9.5900	0.0770	0.7384
P4 Party wall - Roof (insulation at ceiling level)	9.5900	0.0410	0.3932

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.0626 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	48.6503 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4822	42.2354	41.9935	40.8573	40.6447	39.6551	39.6551	39.4719	40.0363	40.6447	41.0748	41.5244	(38)
Heat transfer coeff	91.1325	90.8857	90.6438	89.5076	89.2950	88.3054	88.3054	88.1222	88.6866	89.2950	89.7251	90.1747	(39)
Average = Sum(39)m / 12 =												89.5066	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0406	1.0377	1.0350	1.0220	1.0196	1.0083	1.0083	1.0062	1.0126	1.0196	1.0245	1.0296	(40)
HLP (average)												1.0220	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.5911 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

29.2211	28.7872	28.1760	27.0492	26.2055	25.2699	24.7646	25.3714	26.0322	27.0333	28.1833	29.1223	(42b)

Hot water usage for other uses

41.1657	39.6688	38.1719	36.6749	35.1780	33.6810	33.6810	35.1780	36.6749	38.1719	39.6688	41.1657	(42c)

Average daily hot water use (litres/day)		64.5160 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	70.3869	68.4559	66.3479	63.7241	61.3835	58.9510	58.4456	60.5494	62.7071	65.2051	67.8521	70.2881	(44)
Energy conte	111.4756	97.4804	101.9742	87.2352	82.6339	72.4871	70.6849	74.9728	77.3241	88.4827	96.6677	110.0541	(45)

Energy content (annual)	Total = Sum(45)m =	1071.4726

Distribution loss (46)m = 0.15 x (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	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

94.7542	82.8583	86.6781	74.1499	70.2388	61.6140	60.0822	63.7269	65.7255	75.2103	82.1675	93.5460	(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

	94.7542	82.8583	86.6781	74.1499	70.2388	61.6140	60.0822	63.7269	65.7255	75.2103	82.1675	93.5460	(64)
									Total per year (kWh/year) = Sum(64)m =			910.7517	(64)
12Total per year (kWh/year)												911	(64)
Electric shower(s)													
	54.1879	48.2819	52.7220	50.3119	51.2560	48.8933	50.5230	51.2560	50.3119	52.7220	51.7306	54.1879	(64a)
							Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =					616.3844	(64a)
Heat gains from water heating, kWh/month													
	37.2355	32.7850	34.8500	31.1155	30.3737	27.6268	27.6513	28.7457	29.0094	31.9831	33.4745	36.9335	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	122.9722	136.1478	122.9722	127.0712	122.9722	127.0712	122.9722	122.9722	127.0712	122.9722	127.0712	122.9722	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	234.5544	236.9884	230.8549	217.7975	201.3149	185.8236	175.4744	173.0405	179.1739	192.2313	208.7139	224.2053	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	(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)													
	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	(71)
Water heating gains (Table 5)													
	50.0478	48.7873	46.8414	43.2159	40.8249	38.3706	37.1657	38.6367	40.2908	42.9880	46.4924	49.6418	(72)
Total internal gains													
	469.4413	483.7903	462.5354	449.9516	426.9789	413.1323	397.4792	396.5163	408.4028	420.0584	444.1445	458.6861	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.8000	10.6334	0.3000	0.0000	0.7700	4.4214	(74)
East	5.1600	19.6403	0.3000	0.0000	0.7700	23.4104	(76)
West	7.3200	19.6403	0.3000	0.0000	0.7700	33.2101	(80)

Solar gains	61.0419	119.2112	196.7665	289.0945	357.0995	367.0104	348.7965	297.5737	229.4116	141.4861	76.0535	50.2478	(83)
Total gains	530.4832	603.0015	659.3019	739.0461	784.0784	780.1427	746.2757	694.0900	637.8144	561.5445	520.1979	508.9339	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.4198	55.5703	55.7186	56.4259	56.5603	57.1941	57.1941	57.3131	56.9483	56.5603	56.2892	56.0085	
alpha	4.6947	4.7047	4.7146	4.7617	4.7707	4.8129	4.8129	4.8209	4.7966	4.7707	4.7526	4.7339	
util living area													
	0.9954	0.9909	0.9803	0.9421	0.8496	0.6744	0.5096	0.5650	0.8099	0.9621	0.9908	0.9962	(86)
MIT	19.5621	19.7467	20.0324	20.4382	20.7612	20.9432	20.9880	20.9808	20.8612	20.4355	19.9376	19.5383	(87)
Th 2	20.0497	20.0520	20.0543	20.0650	20.0670	20.0764	20.0764	20.0782	20.0728	20.0670	20.0630	20.0587	(88)
util rest of house													
	0.9941	0.9883	0.9746	0.9249	0.8062	0.5947	0.4080	0.4606	0.7429	0.9473	0.9878	0.9951	(89)
MIT 2	18.7360	18.9212	19.2054	19.6063	19.8999	20.0479	20.0728	20.0717	19.9915	19.6116	19.1204	18.7193	(90)
Living area fraction									fLA = Living area / (4) =			0.1908	(91)
MIT	18.8936	19.0787	19.3632	19.7650	20.0642	20.2187	20.2474	20.2451	20.1574	19.7688	19.2763	18.8756	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8936	19.0787	19.3632	19.7650	20.0642	20.2187	20.2474	20.2451	20.1574	19.7688	19.2763	18.8756	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9919	0.9849	0.9693	0.9182	0.8060	0.6077	0.4273	0.4802	0.7497	0.9414	0.9844	0.9933	(94)
Useful gains	526.1975	593.8739	639.0338	678.6125	631.9882	474.1205	318.8509	333.2889	478.1983	528.6147	512.0711	505.5221	(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													
	1329.9554	1288.6401	1165.9692	972.5003	746.8819	496.1603	322.0834	338.8421	537.2116	818.7264	1092.5206	1323.3656	(97)
Space heating kWh													
	597.9958	466.8829	392.0399	211.5992	85.4809	0.0000	0.0000	0.0000	0.0000	215.8431	417.9237	608.4756	(98a)
Space heating requirement - total per year (kWh/year)												2996.2411	
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													
	597.9958	466.8829	392.0399	211.5992	85.4809	0.0000	0.0000	0.0000	0.0000	215.8431	417.9237	608.4756	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2996.2411	
Space heating per m2											(98c) / (4) =	34.2115	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	830.0709	653.4601	669.7284	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8425	0.9082	0.8782	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	699.3231	593.4668	588.1580	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	860.4124	823.3386	764.7920	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	115.9843	171.0246	131.4157	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													

	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	28.9961	42.7561	32.8539	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement 104.6061 (107)
Energy for space heating 34.2115 (99)
Energy for space cooling 1.1944 (108)
Total 35.4059 (109)
Fabric Energy Efficiency (DFEE) 35.4 (109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7900 (1b)	x	2.3100 (2b)	=	101.1549	(1b) - (3b)
First floor	43.7900 (1c)	x	2.6900 (2c)	=	117.7951	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.9500	(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)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1370	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3870	(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) =	0.3290	(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													
	0.4194	0.4112	0.4030	0.3619	0.3536	0.3125	0.3125	0.3043	0.3290	0.3536	0.3701	0.3865	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

Effective ac	0.5880	0.5845	0.5812	0.5655	0.5625	0.5488	0.5488	0.5463	0.5541	0.5625	0.5685	0.5747	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			43.7900	0.1300	5.6927			(28a)
Main	93.6000	16.4300	77.1700	0.1800	13.8906			(29a)
PIJ	43.7900		43.7900	0.1100	4.8169			(30)
Total net area of external elements Aum(A, m2)			181.1800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.9013			(33)
Party Wall 1			47.9500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 207.6042 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3	Sill	11.5800	0.0500	0.5790
E4	Jamb	26.1000	0.0500	1.3050
E5	Ground floor (normal)	18.7200	0.1600	2.9952
E6	Intermediate floor within a dwelling	18.7200	0.0000	0.0000
E16	Corner (normal)	10.0000	0.0900	0.9000
E18	Party wall between dwellings	10.0000	0.0600	0.6000
P1	Party wall - Ground floor	9.5900	0.0800	0.7672
E10	Eaves (insulation at ceiling level)	9.1300	0.0600	0.5478
E12	Gable (insulation at ceiling level)	9.5900	0.0600	0.5754
P4	Party wall - Roof (insulation at ceiling level)	9.5900	0.1200	1.1508

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.9994 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 52.9007 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.4822	42.2354	41.9935	40.8573	40.6447	39.6551	39.6551	39.4719	40.0363	40.6447	41.0748	41.5244	(38)
Heat transfer coeff													
	95.3830	95.1362	94.8943	93.7581	93.5455	92.5559	92.5559	92.3726	92.9371	93.5455	93.9755	94.4251	(39)

Average = Sum(39)m / 12 = 93.7570

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0891	1.0863	1.0835	1.0705	1.0681	1.0568	1.0568	1.0547	1.0612	1.0681	1.0730	1.0782	(40)
HLP (average)												1.0705	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5911 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

29.2211	28.7872	28.1760	27.0492	26.2055	25.2699	24.7646	25.3714	26.0322	27.0333	28.1833	29.1223	(42b)

Hot water usage for other uses

41.1657	39.6688	38.1719	36.6749	35.1780	33.6810	33.6810	35.1780	36.6749	38.1719	39.6688	41.1657	(42c)

Average daily hot water use (litres/day) 64.5160 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	70.3869	68.4559	66.3479	63.7241	61.3835	58.9510	58.4456	60.5494	62.7071	65.2051	67.8521	70.2881	(44)
Energy conte	111.4756	97.4804	101.9742	87.2352	82.6339	72.4871	70.6849	74.9728	77.3241	88.4827	96.6677	110.0541	(45)
Energy content (annual)										Total = Sum(45)m =		1071.4726	
Distribution loss (46)m = 0.15 x (45)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	(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	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													
	94.7542	82.8583	86.6781	74.1499	70.2388	61.6140	60.0822	63.7269	65.7255	75.2103	82.1675	93.5460	(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													
	94.7542	82.8583	86.6781	74.1499	70.2388	61.6140	60.0822	63.7269	65.7255	75.2103	82.1675	93.5460	(64)
									Total per year (kWh/year) = Sum(64)m =			910.7517	(64)
12Total per year (kWh/year)												911	(64)
Electric shower(s)													
	54.1879	48.2819	52.7220	50.3119	51.2560	48.8933	50.5230	51.2560	50.3119	52.7220	51.7306	54.1879	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						616.3844	(64a)
Heat gains from water heating, kWh/month													
	37.2355	32.7850	34.8500	31.1155	30.3737	27.6268	27.6513	28.7457	29.0094	31.9831	33.4745	36.9335	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	129.5563	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	122.9722	136.1478	122.9722	127.0712	122.9722	127.0712	122.9722	122.9722	127.0712	122.9722	127.0712	122.9722	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	234.5544	236.9884	230.8549	217.7975	201.3149	185.8236	175.4744	173.0405	179.1739	192.2313	208.7139	224.2053	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	35.9556	(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)													
	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	(71)
Water heating gains (Table 5)													
	50.0478	48.7873	46.8414	43.2159	40.8249	38.3706	37.1657	38.6367	40.2908	42.9880	46.4924	49.6418	(72)
Total internal gains													
	469.4413	483.7903	462.5354	449.9516	426.9789	413.1323	397.4792	396.5163	408.4028	420.0584	444.1445	458.6861	(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	1.8000	10.6334	0.6300	0.7000	0.7700	5.8495	(74)
East	5.1600	19.6403	0.6300	0.7000	0.7700	30.9720	(76)
West	7.3200	19.6403	0.6300	0.7000	0.7700	43.9370	(80)

Solar gains	80.7584	157.7164	260.3221	382.4721	472.4426	485.5548	461.4578	393.6900	303.5116	187.1861	100.6187	66.4779	(83)
Total gains	550.1997	641.5067	722.8575	832.4236	899.4215	898.6871	858.9370	790.2063	711.9144	607.2445	544.7632	525.1640	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.9502	53.0876	53.2229	53.8679	53.9903	54.5676	54.5676	54.6758	54.3438	53.9903	53.7432	53.4873	
alpha	4.5300	4.5392	4.5482	4.5912	4.5994	4.6378	4.6378	4.6451	4.6229	4.5994	4.5829	4.5658	
util living area													
	0.9947	0.9887	0.9739	0.9219	0.8075	0.6232	0.4662	0.5234	0.7767	0.9537	0.9893	0.9957	(86)
MIT	19.5028	19.7143	20.0367	20.4723	20.7933	20.9534	20.9902	20.9836	20.8728	20.4337	19.8976	19.4738	(87)
Th 2	20.0097	20.0121	20.0143	20.0250	20.0270	20.0363	20.0363	20.0380	20.0327	20.0270	20.0229	20.0187	(88)
util rest of house													
	0.9932	0.9856	0.9664	0.9000	0.7578	0.5425	0.3679	0.4206	0.7042	0.9361	0.9858	0.9945	(89)
MIT 2	18.6467	18.8581	19.1774	19.6025	19.8869	20.0137	20.0334	20.0327	19.9606	19.5762	19.0497	18.6246	(90)
Living area fraction										fLA = Living area / (4) =		0.1908	(91)
MIT	18.8100	19.0215	19.3413	19.7684	20.0598	20.1930	20.2159	20.2141	20.1346	19.7398	19.2115	18.7866	(92)

Temperature adjustment												0.0000	
adjusted MIT	18.8100	19.0215	19.3413	19.7684	20.0598	20.1930	20.2159	20.2141	20.1346	19.7398	19.2115	18.7866	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9907	0.9815	0.9600	0.8932	0.7596	0.5562	0.3866	0.4400	0.7126	0.9296	0.9819	0.9924	(94)
Useful gains	545.0912	629.6109	693.9135	743.4918	683.2369	499.8771	332.0809	347.6903	507.3359	564.4764	534.9010	521.1655	(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													
	1384.0102	1343.4650	1218.5681	1019.0048	782.0255	517.6672	334.6745	352.3208	560.8405	854.9875	1138.1813	1377.3415	(97)
Space heating kWh													
	624.1557	479.7100	390.3431	198.3694	73.4987	0.0000	0.0000	0.0000	0.0000	216.1403	434.3619	636.9949	(98a)
Space heating requirement - total per year (kWh/year)												3053.5740	
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													
	624.1557	479.7100	390.3431	198.3694	73.4987	0.0000	0.0000	0.0000	0.0000	216.1403	434.3619	636.9949	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3053.5740	
Space heating per m2											(98c) / (4) =	34.8661	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	870.0252	684.9135	702.0319	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8744	0.9285	0.9008	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	760.7177	635.9446	632.4098	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	998.9708	955.0206	877.1357	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	171.5422	237.3925	182.0761	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	42.8856	59.3481	45.5190	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												147.7527	(107)
Energy for space heating												34.8661	(99)
Energy for space cooling												1.6871	(108)
Total												36.5532	(109)
Fabric Energy Efficiency (TFEE)												36.6	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7900 (1b)	x	2.3100 (2b)	=	101.1549	(1b) - (3b)
First floor	43.7900 (1c)	x	2.6900 (2c)	=	117.7951	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.9500	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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													
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			43.7900	0.1100	4.8169	75.0000	3284.2500	(28a)
Main	93.6000	16.4300	77.1700	0.1800	13.8906	110.0000	8488.6999	(29a)
PIJ	43.7900		43.7900	0.1000	4.3790	9.0000	394.1100	(30)
Total net area of external elements Aum(A, m2)			181.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.5876			(33)
Party Wall 1			47.9500	0.0000	0.0000	70.0000	3356.5000	(32)
Internal Wall 1			164.0100			9.0000	1476.0900	(32c)
Internal Floor 1			43.7900			18.0000	788.2200	(32d)
Internal Ceiling 1			43.7900			9.0000	394.1100	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 18181.9799 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 207.6042 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3	Sill	11.5800	0.0200	0.2316
E4	Jamb	26.1000	0.0160	0.4176
E5	Ground floor (normal)	18.7200	0.1080	2.0218
E6	Intermediate floor within a dwelling	18.7200	0.0000	0.0000
E16	Corner (normal)	10.0000	0.0510	0.5100
E18	Party wall between dwellings	10.0000	0.0290	0.2900
P1	Party wall - Ground floor	9.5900	0.0800	0.7672
E10	Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139
E12	Gable (insulation at ceiling level)	9.5900	0.0770	0.7384
P4	Party wall - Roof (insulation at ceiling level)	9.5900	0.0410	0.3932

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.0626 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 48.6503 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.6396	37.2557	36.8719	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	(38)
Heat transfer coeff	86.2898	85.9060	85.5221	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	(39)
Average = Sum(39)m / 12 =												85.0593	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9853	0.9809	0.9765	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	(40)
HLP (average)												0.9712	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5911 (42)
Hot water usage for mixer showers

67.6644	66.6475	65.1658	62.3307	60.2384	57.9052	56.5790	58.0495	59.6615	62.1667	65.0627	67.4052	(42a)

Hot water usage for baths

29.2211	28.7872	28.1760	27.0492	26.2055	25.2699	24.7646	25.3714	26.0322	27.0333	28.1833	29.1223	(42b)

Hot water usage for other uses

41.1657	39.6688	38.1719	36.6749	35.1780	33.6810	33.6810	35.1780	36.6749	38.1719	39.6688	41.1657	(42c)

Average daily hot water use (litres/day) 126.9003 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.0513	135.1035	131.5137	126.0548	121.6219	116.8562	115.0246	118.5989	122.3686	127.3718	132.9148	137.6932	(44)
Energy conte	218.6395	192.3856	202.1316	172.5627	163.7265	143.6883	139.1123	146.8503	150.8927	172.8424	189.3615	215.5943	(45)
Energy content (annual)										Total = Sum(45)m =		2107.7876	

Distribution loss (46)m = 0.15 x (45)m

32.7959	28.8578	30.3197	25.8844	24.5590	21.5532	20.8668	22.0275	22.6339	25.9264	28.4042	32.3391	(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 14.8728	13.4182	14.8233	14.2760	14.7081	14.1894	14.6342	14.6575	14.2110	14.7354	14.3264	14.8637	(61)

Total heat required for water heating calculated for each month

233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(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

233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
									Total per year (kWh/year) = Sum(64)m =		2281.5036	(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

76.4158	67.3228	70.9146	60.9461	58.1161	51.3237	49.9134	52.4921	53.7246	61.1540	66.5443	75.4010	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

35.1414	31.2123	25.3836	19.2170	14.3649	12.1275	13.1042	17.0333	22.8620	29.0286	33.8807	36.1181	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

350.0813	353.7140	344.5596	325.0709	300.4700	277.3486	261.9021	258.2694	267.4238	286.9124	311.5133	334.6347	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379 (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)												
	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450 (71)
Water heating gains (Table 5)												
	102.7094	100.1827	95.3153	84.6474	78.1130	71.2829	67.0879	70.5539	74.6175	82.1962	92.4226	101.3455 (72)
Total internal gains												
	595.8926	593.0694	573.2189	536.8957	500.9084	465.7194	447.0546	450.8169	469.8637	506.0976	545.7771	580.0588 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.8000	10.6334	0.3000	0.0000	0.7700	4.4214	(74)
East	5.1600	19.6403	0.3000	0.0000	0.7700	23.4104	(76)
West	7.3200	19.6403	0.3000	0.0000	0.7700	33.2101	(80)

Solar gains	61.0419	119.2112	196.7665	289.0945	357.0995	367.0104	348.7965	297.5737	229.4116	141.4861	76.0535	50.2478	(83)
Total gains	656.9344	712.2806	769.9854	825.9903	858.0079	832.7298	795.8511	748.3907	699.2753	647.5838	621.8305	630.3066	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5301	58.7916	59.0555	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	
alpha	4.9020	4.9194	4.9370	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	
util living area													
	0.9883	0.9811	0.9617	0.9086	0.7955	0.6223	0.4629	0.5111	0.7506	0.9320	0.9799	0.9902	(86)
MIT	19.8407	19.9971	20.2671	20.5954	20.8444	20.9642	20.9932	20.9890	20.9117	20.5912	20.1636	19.8241	(87)
Th 2	20.0956	20.0993	20.1030	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	(88)
util rest of house													
	0.9853	0.9763	0.9518	0.8851	0.7474	0.5466	0.3721	0.4170	0.6804	0.9093	0.9739	0.9877	(89)
MIT 2	19.0477	19.2048	19.4714	19.7878	20.0046	20.0925	20.1080	20.1065	20.0605	19.7906	19.3791	19.0427	(90)
Living area fraction									fLA = Living area / (4) =			0.1908	(91)
MIT	19.1990	19.3560	19.6232	19.9419	20.1649	20.2588	20.2769	20.2749	20.2229	19.9433	19.5288	19.1918	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0490	19.2060	19.4732	19.7919	20.0149	20.1088	20.1269	20.1249	20.0729	19.7933	19.3788	19.0418	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9807	0.9701	0.9431	0.8753	0.7417	0.5465	0.3739	0.4186	0.6772	0.8994	0.9674	0.9837	(94)
Useful gains	644.2519	690.9735	726.1619	723.0022	636.3747	455.0762	297.5605	313.2659	473.5166	582.4355	601.5711	620.0214	(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													
	1272.6869	1228.9687	1109.4964	923.3840	704.9085	467.0221	299.0012	315.7824	506.3650	779.3830	1040.9580	1258.2428	(97)
Space heating kWh													
	467.5557	361.5327	285.2009	144.2749	50.9892	0.0000	0.0000	0.0000	0.0000	146.5289	316.3586	474.8367	(98a)
Space heating requirement - total per year (kWh/year)												2247.2776	
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													
	467.5557	361.5327	285.2009	144.2749	50.9892	0.0000	0.0000	0.0000	0.0000	146.5289	316.3586	474.8367	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2247.2776	
Space heating per m2											(98c) / (4) =	25.6597	(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 %) 89.0000 (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													
	467.5557	361.5327	285.2009	144.2749	50.9892	0.0000	0.0000	0.0000	0.0000	146.5289	316.3586	474.8367	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	525.3434	406.2166	320.4505	162.1067	57.2912	0.0000	0.0000	0.0000	0.0000	164.6393	355.4591	533.5244	(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													
	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4265	88.3757	88.2575	88.0327	87.6722	87.3000	87.3000	87.3000	87.3000	88.0375	88.3263	88.4373	(217)
Fuel for water heating, kWh/month													
	264.0751	232.8737	245.8205	212.2379	203.5247	180.8449	176.1128	185.0031	189.1223	213.0658	230.6083	260.5892	(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	10.8592	9.8083	10.8592	10.5089	10.8592	10.5089	10.8592	10.8592	10.5089	10.8592	10.5089	10.8592	(231)
Lighting	30.7591	24.6761	22.2181	16.2779	12.5735	10.2727	11.4700	14.9091	19.3655	25.4086	28.6989	31.6140	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.6184	-41.8641	-67.4493	-82.6566	-93.0984	-88.1433	-86.6946	-79.6381	-67.0016	-50.5980	-30.4527	-22.3228	(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	(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	(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	(235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m	-10.9144	-26.6731	-63.6629	-111.7920	-161.8210	-168.1210	-163.8288	-129.7425	-83.6205	-41.0535	-15.2628	-8.2614 (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	(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	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2525.0311	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.3000	
Water heating fuel used	2593.8784	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)		
mechanical ventilation fans (SFP = 0.1567)	41.8583	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	127.8583	(231)
Electricity for lighting (calculated in Appendix L)	248.2436	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1721.2916	(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	3773.7197	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2525.0311	3.6400	91.9111	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2593.8784	3.6400	94.4172	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	127.8583	16.4900	21.0838	(249)
Energy for lighting	248.2436	16.4900	40.9354	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-736.5379	16.4900	-121.4551	
PV Unit electricity exported	-984.7537	5.5900	-55.0477	
Total			-176.5028	(252)
Total energy cost			163.8447	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4449	(257)
SAP value	92.7883	
SAP rating (Section 12)	93	(258)
SAP band	A	

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	2525.0311	0.2100	530.2565	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2593.8784	0.2100	544.7145	(264)
Space and water heating			1074.9710	(265)
Pumps, fans and electric keep-hot	127.8583	0.1387	17.7355	(267)
Energy for lighting	248.2436	0.1443	35.8292	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-736.5379	0.1329	-97.8779	
PV Unit electricity exported	-984.7537	0.1222	-120.3569	
Total			-218.2348	(269)
Total CO2, kg/year			910.3009	(272)
CO2 emissions per m2			10.3900	(273)
EI value			90.7995	
EI rating			91	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7900 (1b)	x	2.3100 (2b)	=	101.1549	(1b) - (3b)
First floor	43.7900 (1c)	x	2.6900 (2c)	=	117.7951	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.9500	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			43.7900	0.1100	4.8169	75.0000	3284.2500	(28a)
Main	93.6000	16.4300	77.1700	0.1800	13.8906	110.0000	8488.6999	(29a)
PIJ	43.7900		43.7900	0.1000	4.3790	9.0000	394.1100	(30)
Total net area of external elements Aum(A, m2)			181.1800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.5876			(33)
Party Wall 1			47.9500	0.0000	0.0000	70.0000	3356.5000	(32)
Internal Wall 1			164.0100			9.0000	1476.0900	(32c)
Internal Floor 1			43.7900			18.0000	788.2200	(32d)
Internal Ceiling 1			43.7900			9.0000	394.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18181.9799	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	207.6042	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0200	0.2316
E4 Jamb	26.1000	0.0160	0.4176
E5 Ground floor (normal)	18.7200	0.1080	2.0218
E6 Intermediate floor within a dwelling	18.7200	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0510	0.5100
E18 Party wall between dwellings	10.0000	0.0290	0.2900
P1 Party wall - Ground floor	9.5900	0.0800	0.7672
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139
E12 Gable (insulation at ceiling level)	9.5900	0.0770	0.7384
P4 Party wall - Roof (insulation at ceiling level)	9.5900	0.0410	0.3932

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.0626	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 48.6503	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	(38)
Heat transfer coeff	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	(39)
Average = Sum(39)m / 12 =												84.7770	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	(40)
HLP (average)												0.9680	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5911	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	67.6644	66.6475	65.1658	62.3307	60.2384	57.9052	56.5790	58.0495	59.6615	62.1667	65.0627	67.4052	(42a)
Hot water usage for baths	29.2211	28.7872	28.1760	27.0492	26.2055	25.2699	24.7646	25.3714	26.0322	27.0333	28.1833	29.1223	(42b)

Hot water usage for other uses

41.1657	39.6688	38.1719	36.6749	35.1780	33.6810	33.6810	35.1780	36.6749	38.1719	39.6688	41.1657	(42c)

Average daily hot water use (litres/day) 126.9003 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.0513	135.1035	131.5137	126.0548	121.6219	116.8562	115.0246	118.5989	122.3686	127.3718	132.9148	137.6932	(44)
Energy conte	218.6395	192.3856	202.1316	172.5627	163.7265	143.6883	139.1123	146.8503	150.8927	172.8424	189.3615	215.5943	(45)

Energy content (annual) Total = Sum(45)m = 2107.7876

Distribution loss (46)m = 0.15 x (45)m													
	32.7959	28.8578	30.3197	25.8844	24.5590	21.5532	20.8668	22.0275	22.6339	25.9264	28.4042	32.3391	(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	14.8728	13.4182	14.8233	14.2760	14.7081	14.1894	14.6342	14.6575	14.2110	14.7354	14.3264	14.8637	(61)
Total heat required for water heating calculated for each month													
	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(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													
	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)

Total per year (kWh/year) = Sum(64)m = 2281.5036 (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													
	76.4158	67.3228	70.9146	60.9461	58.1161	51.3237	49.9134	52.4921	53.7246	61.1540	66.5443	75.4010	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.1414	31.2123	25.3836	19.2170	14.3649	12.1275	13.1042	17.0333	22.8620	29.0286	33.8807	36.1181	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	350.0813	353.7140	344.5596	325.0709	300.4700	277.3486	261.9021	258.2694	267.4238	286.9124	311.5133	334.6347	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	(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)													
	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	(71)
Water heating gains (Table 5)													
	102.7094	100.1827	95.3153	84.6474	78.1130	71.2829	67.0879	70.5539	74.6175	82.1962	92.4226	101.3455	(72)
Total internal gains													
	595.8926	593.0694	573.2189	536.8957	500.9084	465.7194	447.0546	450.8169	469.8637	506.0976	545.7771	580.0588	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.8000	9.8154	0.3000	0.0000	0.7700	4.0813	(74)
East	5.1600	18.1295	0.3000	0.0000	0.7700	21.6096	(76)
West	7.3200	18.1295	0.3000	0.0000	0.7700	30.6555	(80)

Solar gains	56.3464	112.5884	182.4190	269.8216	342.2204	348.6599	334.0326	280.5154	217.4423	135.0549	71.4442	50.2478	(83)
Total gains	652.2389	705.6578	755.6378	806.7173	843.1287	814.3793	781.0872	731.3323	687.3060	641.1526	617.2212	630.3066	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
tau	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	
alpha	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	
util living area													
	0.9872	0.9800	0.9598	0.9057	0.7832	0.5833	0.4302	0.4690	0.7371	0.9298	0.9787	0.9895	(86)
MIT	19.9154	20.0477	20.3091	20.6161	20.8616	20.9755	20.9955	20.9933	20.9222	20.6053	20.1933	19.8607	(87)
Th 2	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	(88)
util rest of house													
	0.9839	0.9749	0.9491	0.8809	0.7317	0.5021	0.3365	0.3704	0.6627	0.9061	0.9722	0.9867	(89)
MIT 2	19.1332	19.2634	19.5182	19.8075	20.0188	20.0993	20.1089	20.1082	20.0681	19.8039	19.4084	19.0792	(90)
Living area fraction										fLA = Living area / (4) =		0.1908	(91)
MIT	19.2824	19.4130	19.6691	19.9618	20.1796	20.2664	20.2781	20.2771	20.2311	19.9568	19.5581	19.2283	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1324	19.2630	19.5191	19.8118	20.0296	20.1164	20.1281	20.1271	20.0811	19.8068	19.4081	19.0783	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9790	0.9685	0.9404	0.8711	0.7266	0.5027	0.3385	0.3723	0.6601	0.8962	0.9655	0.9825	(94)
Useful gains	638.5737	683.4552	710.5887	702.7352	612.6486	409.3826	264.3738	272.2907	453.6821	574.5862	595.9565	619.2469	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W													
	1223.5375	1192.2204	1069.8108	891.1600	672.2467	416.8011	265.1898	273.5843	481.6230	763.5676	1018.0136	1235.9032	(97)
Space heating kWh													
	435.2130	341.8902	267.2613	135.6659	44.3410	0.0000	0.0000	0.0000	0.0000	140.6022	303.8811	458.7922	(98a)

Space heating requirement - total per year (kWh/year) 2127.6469

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	(98b)
Solar heating contribution - total per year (kWh/year)											0.0000	
Space heating kWh												
	435.2130	341.8902	267.2613	135.6659	44.3410	0.0000	0.0000	0.0000	0.0000	140.6022	303.8811	458.7922 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)											2127.6469	
Space heating per m2										(98c) / (4) =	24.2938	(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 %)											89.0000	(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													
	435.2130	341.8902	267.2613	135.6659	44.3410	0.0000	0.0000	0.0000	0.0000	140.6022	303.8811	458.7922	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	489.0034	384.1463	300.2936	152.4336	49.8214	0.0000	0.0000	0.0000	0.0000	157.9800	341.4394	515.4969	(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													
	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.3989	88.3535	88.2302	88.0072	87.6332	87.3000	87.3000	87.3000	87.3000	88.0203	88.3099	88.4243	(217)
Fuel for water heating, kWh/month													
	264.1574	232.9323	245.8964	212.2995	203.6153	180.8449	176.1128	185.0031	189.1223	213.1074	230.6512	260.6276	(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	10.8592	9.8083	10.8592	10.5089	10.8592	10.5089	10.8592	10.8592	10.5089	10.8592	10.5089	10.8592	(231)
Lighting	30.7591	24.6761	22.2181	16.2779	12.5735	10.2727	11.4700	14.9091	19.3655	25.4086	28.6989	31.6140	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.9116	-40.1033	-64.1285	-79.4666	-91.1737	-86.0803	-84.9733	-77.2606	-64.9106	-48.9769	-28.9748	-22.3228	(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	-9.7341	-24.6262	-57.4234	-102.0188	-153.1239	-157.3707	-154.9460	-120.1173	-77.8528	-38.5087	-13.9700	-8.2614	(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												2390.6145	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2594.3704	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)													
mechanical ventilation fans (SFP = 0.1567)												41.8583	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												127.8583	(231)
Electricity for lighting (calculated in Appendix L)												248.2436	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1631.2365	(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												3729.8502	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2390.6145	4.8000	114.7495	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2594.3704	4.8000	124.5298	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	127.8583	21.5100	27.5023	(249)
Energy for lighting	248.2436	21.5100	53.3972	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-713.2831	21.5100	-153.4272	
PV Unit electricity exported	-917.9534	5.5900	-51.3136	
Total			-204.7408	(252)
Total energy cost			213.4380	(255)

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	2390.6145	0.2100	502.0290	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2594.3704	0.2100	544.8178	(264)
Space and water heating			1046.8468	(265)
Pumps, fans and electric keep-hot	127.8583	0.1387	17.7355	(267)
Energy for lighting	248.2436	0.1443	35.8292	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-713.2831	0.1328	-94.6961	
PV Unit electricity exported	-917.9534	0.1220	-111.9715	
Total			-206.6676	(269)
Total CO2, kg/year			893.7440	(272)

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	2390.6145	1.1300	2701.3943	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2594.3704	1.1300	2931.6385	(278)
Space and water heating			5633.0329	(279)
Pumps, fans and electric keep-hot	127.8583	1.5128	193.4240	(281)
Energy for lighting	248.2436	1.5338	380.7643	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-713.2831	1.4906	-1063.1943	
PV Unit electricity exported	-917.9534	0.4475	-410.8295	
Total			-1474.0238	(283)
Total Primary energy kWh/year			4733.1974	(286)

SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating: A 93
Current environmental impact rating: B 91

N	Solar water heating	SAP increase too small
U	Solar photovoltaic panels	Already installed
V2	Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
(none)			
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.6	-£ 15	-123 kg (13.8%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: A 93
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, East Pennines):

	Current	Potential	Saving
Electricity	£81	£81	£0
Mains gas	£337	£337	£0
Space heating	£240	£240	£0
Water heating	£125	£125	£0
Lighting	£53	£53	£0
Generated (PV)	-£205	-£205	£0
Total cost of fuels	£213	£213	£0
Total cost of uses	£213	£213	£0
Delivered energy	43 kWh/m²	43 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.9 tonnes	0.0 tonnes
CO2 emissions per m²	10 kg/m²	10 kg/m²	0 kg/m²
Primary energy	54 kWh/m²	54 kWh/m²	0 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7900 (1b)	x	2.3100 (2b)	=	101.1549 (1b) - (3b)	
First floor	43.7900 (1c)	x	2.6900 (2c)	=	117.7951 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800					(4)

Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 218.9500 (5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			43.7900	0.1100	4.8169	75.0000	3284.2500	(28a)
Main	93.6000	16.4300	77.1700	0.1800	13.8906	110.0000	8488.6999	(29a)
PIJ	43.7900		43.7900	0.1000	4.3790	9.0000	394.1100	(30)
Total net area of external elements Aum(A, m2)			181.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.5876			(33)
Party Wall 1			47.9500	0.0000	0.0000	70.0000	3356.5000	(32)
Internal Wall 1			164.0100			9.0000	1476.0900	(32c)
Internal Floor 1			43.7900			18.0000	788.2200	(32d)
Internal Ceiling 1			43.7900			9.0000	394.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	18181.9799 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		207.6042 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790
E3 Sill	11.5800	0.0200	0.2316
E4 Jamb	26.1000	0.0160	0.4176
E5 Ground floor (normal)	18.7200	0.1080	2.0218
E6 Intermediate floor within a dwelling	18.7200	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0510	0.5100
E18 Party wall between dwellings	10.0000	0.0290	0.2900
P1 Party wall - Ground floor	9.5900	0.0800	0.7672
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139
E12 Gable (insulation at ceiling level)	9.5900	0.0770	0.7384
P4 Party wall - Roof (insulation at ceiling level)	9.5900	0.0410	0.3932

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.0626 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	48.6503 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.6396	37.2557	36.8719	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	(38)
Heat transfer coeff	86.2898	85.9060	85.5221	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	(39)
Average = Sum(39)m / 12 =												85.0593	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9853	0.9809	0.9765	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	(40)
HLP (average)												0.9712	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5911	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
67.6644	66.6475	65.1658	62.3307	60.2384	57.9052	56.5790	58.0495	59.6615	62.1667	65.0627	67.4052	(42a)

Hot water usage for baths

29.2211	28.7872	28.1760	27.0492	26.2055	25.2699	24.7646	25.3714	26.0322	27.0333	28.1833	29.1223	(42b)

Hot water usage for other uses

41.1657	39.6688	38.1719	36.6749	35.1780	33.6810	33.6810	35.1780	36.6749	38.1719	39.6688	41.1657	(42c)
Average daily hot water use (litres/day)												126.9003	(43)

Daily hot water use

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
138.0513	135.1035	131.5137	126.0548	121.6219	116.8562	115.0246	118.5989	122.3686	127.3718	132.9148	137.6932	(44)

Energy conte	218.6395	192.3856	202.1316	172.5627	163.7265	143.6883	139.1123	146.8503	150.8927	172.8424	189.3615	215.5943	(45)
Energy content (annual)										Total = Sum(45)m =		2107.7876	
Distribution loss (46)m = 0.15 x (45)m													
	32.7959	28.8578	30.3197	25.8844	24.5590	21.5532	20.8668	22.0275	22.6339	25.9264	28.4042	32.3391	(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	14.8728	13.4182	14.8233	14.2760	14.7081	14.1894	14.6342	14.6575	14.2110	14.7354	14.3264	14.8637	(61)
Total heat required for water heating calculated for each month													
	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(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													
	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
										Total per year (kWh/year) = Sum(64)m =		2281.5036	(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													
	76.4158	67.3228	70.9146	60.9461	58.1161	51.3237	49.9134	52.4921	53.7246	61.1540	66.5443	75.4010	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.1414	31.2123	25.3836	19.2170	14.3649	12.1275	13.1042	17.0333	22.8620	29.0286	33.8807	36.1181	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	350.0813	353.7140	344.5596	325.0709	300.4700	277.3486	261.9021	258.2694	267.4238	286.9124	311.5133	334.6347	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	(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)													
	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	(71)
Water heating gains (Table 5)													
	102.7094	100.1827	95.3153	84.6474	78.1130	71.2829	67.0879	70.5539	74.6175	82.1962	92.4226	101.3455	(72)
Total internal gains													
	595.8926	593.0694	573.2189	536.8957	500.9084	465.7194	447.0546	450.8169	469.8637	506.0976	545.7771	580.0588	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.8000	10.6334	0.3000	0.0000	0.7700	4.4214	(74)
East	5.1600	19.6403	0.3000	0.0000	0.7700	23.4104	(76)
West	7.3200	19.6403	0.3000	0.0000	0.7700	33.2101	(80)

Solar gains	61.0419	119.2112	196.7665	289.0945	357.0995	367.0104	348.7965	297.5737	229.4116	141.4861	76.0535	50.2478	(83)
Total gains	656.9344	712.2806	769.9854	825.9903	858.0079	832.7298	795.8511	748.3907	699.2753	647.5838	621.8305	630.3066	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5301	58.7916	59.0555	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	
alpha	4.9020	4.9194	4.9370	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	
util living area													
	0.9883	0.9811	0.9617	0.9086	0.7955	0.6223	0.4629	0.5111	0.7506	0.9320	0.9799	0.9902	(86)
MIT	19.8407	19.9971	20.2671	20.5954	20.8444	20.9642	20.9932	20.9890	20.9117	20.5912	20.1636	19.8241	(87)
Th 2	20.0956	20.0993	20.1030	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	(88)
util rest of house													
	0.9853	0.9763	0.9518	0.8851	0.7474	0.5466	0.3721	0.4170	0.6804	0.9093	0.9739	0.9877	(89)
MIT 2	19.0477	19.2048	19.4714	19.7878	20.0046	20.0925	20.1080	20.1065	20.0605	19.7906	19.3791	19.0427	(90)
Living area fraction										fLA = Living area / (4) =		0.1908	(91)
MIT	19.1990	19.3560	19.6232	19.9419	20.1649	20.2588	20.2769	20.2749	20.2229	19.9433	19.5288	19.1918	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0490	19.2060	19.4732	19.7919	20.0149	20.1088	20.1269	20.1249	20.0729	19.7933	19.3788	19.0418	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9807	0.9701	0.9431	0.8753	0.7417	0.5465	0.3739	0.4186	0.6772	0.8994	0.9674	0.9837	(94)
Useful gains	644.2519	690.9735	726.1619	723.0022	636.3747	455.0762	297.5605	313.2659	473.5166	582.4355	601.5711	620.0214	(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													
	1272.6869	1228.9687	1109.4964	923.3840	704.9085	467.0221	299.0012	315.7824	506.3650	779.3830	1040.9580	1258.2428	(97)
Space heating kWh													
	467.5557	361.5327	285.2009	144.2749	50.9892	0.0000	0.0000	0.0000	0.0000	146.5289	316.3586	474.8367	(98a)
Space heating requirement - total per year (kWh/year)												2247.2776	
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													
	467.5557	361.5327	285.2009	144.2749	50.9892	0.0000	0.0000	0.0000	0.0000	146.5289	316.3586	474.8367	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2247.2776	
Space heating per m2											(98c) / (4) =	25.6597	(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 %)												89.0000	(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													
	467.5557	361.5327	285.2009	144.2749	50.9892	0.0000	0.0000	0.0000	0.0000	146.5289	316.3586	474.8367	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	525.3434	406.2166	320.4505	162.1067	57.2912	0.0000	0.0000	0.0000	0.0000	164.6393	355.4591	533.5244	(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													
	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4265	88.3757	88.2575	88.0327	87.6722	87.3000	87.3000	87.3000	87.3000	88.0375	88.3263	88.4373	(217)
Fuel for water heating, kWh/month													
	264.0751	232.8737	245.8205	212.2379	203.5247	180.8449	176.1128	185.0031	189.1223	213.0658	230.6083	260.5892	(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	10.8592	9.8083	10.8592	10.5089	10.8592	10.5089	10.8592	10.8592	10.5089	10.8592	10.5089	10.8592	(231)
Lighting	30.7591	24.6761	22.2181	16.2779	12.5735	10.2727	11.4700	14.9091	19.3655	25.4086	28.6989	31.6140	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.6184	-41.8641	-67.4493	-82.6566	-93.0984	-88.1433	-86.6946	-79.6381	-67.0016	-50.5980	-30.4527	-22.3228	(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	-10.9144	-26.6731	-63.6629	-111.7920	-161.8210	-168.1210	-163.8288	-129.7425	-83.6205	-41.0535	-15.2628	-8.2614	(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												2525.0311	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2593.8784	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)													
mechanical ventilation fans (SFP = 0.1567)												41.8583	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												127.8583	(231)
Electricity for lighting (calculated in Appendix L)												248.2436	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1721.2916	(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												3773.7197	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2525.0311	3.6400	91.9111	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2593.8784	3.6400	94.4172	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	127.8583	16.4900	21.0838	(249)
Energy for lighting	248.2436	16.4900	40.9354	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-736.5379	16.4900	-121.4551	
PV Unit electricity exported	-984.7537	5.5900	-55.0477	
Total			-176.5028	(252)
Total energy cost			163.8447	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4449	(257)
SAP value		92.7883	
SAP rating (Section 12)		93	(258)
SAP band		A	

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	2525.0311	0.2100	530.2565	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2593.8784	0.2100	544.7145	(264)
Space and water heating			1074.9710	(265)
Pumps, fans and electric keep-hot	127.8583	0.1387	17.7355	(267)
Energy for lighting	248.2436	0.1443	35.8292	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-736.5379	0.1329	-97.8779	
PV Unit electricity exported	-984.7537	0.1222	-120.3569	
Total			-218.2348	(269)
Total CO2, kg/year			910.3009	(272)
CO2 emissions per m2			10.3900	(273)
EI value			90.7995	
EI rating			91	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.7900	(1b)	x 2.3100	(2b) =	101.1549	(1b) - (3b)
First floor	43.7900	(1c)	x 2.6900	(2c) =	117.7951	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		218.9500	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)
Mechanical extract ventilation - decentralised													
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)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			14.2800	1.1450	16.3511			(27)
GF			43.7900	0.1100	4.8169	75.0000	3284.2500	(28a)
Main	93.6000	16.4300	77.1700	0.1800	13.8906	110.0000	8488.6999	(29a)
PIJ	43.7900		43.7900	0.1000	4.3790	9.0000	394.1100	(30)
Total net area of external elements Aum(A, m2)			181.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.5876			(33)
Party Wall 1			47.9500	0.0000	0.0000	70.0000	3356.5000	(32)
Internal Wall 1			164.0100			9.0000	1476.0900	(32c)
Internal Floor 1			43.7900			18.0000	788.2200	(32d)
Internal Ceiling 1			43.7900			9.0000	394.1100	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		18181.9799	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							207.6042	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	11.5800	0.0500	0.5790	
E3 Sill	11.5800	0.0200	0.2316	
E4 Jamb	26.1000	0.0160	0.4176	
E5 Ground floor (normal)	18.7200	0.1080	2.0218	
E6 Intermediate floor within a dwelling	18.7200	0.0000	0.0000	
E16 Corner (normal)	10.0000	0.0510	0.5100	
E18 Party wall between dwellings	10.0000	0.0290	0.2900	
P1 Party wall - Ground floor	9.5900	0.0800	0.7672	
E10 Eaves (insulation at ceiling level)	9.1300	0.1220	1.1139	
E12 Gable (insulation at ceiling level)	9.5900	0.0770	0.7384	
P4 Party wall - Roof (insulation at ceiling level)	9.5900	0.0410	0.3932	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			7.0626	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	48.6503	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	36.1267	(38)
Heat transfer coeff	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	84.7770	(39)
Average = Sum(39)m / 12 =												84.7770	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	0.9680	(40)
HLP (average)												0.9680	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.5911	(42)
Hot water usage for mixer showers	67.6644	66.6475	65.1658	62.3307	60.2384	57.9052	56.5790	58.0495	59.6615	62.1667	65.0627	67.4052	(42a)
Hot water usage for baths	29.2211	28.7872	28.1760	27.0492	26.2055	25.2699	24.7646	25.3714	26.0322	27.0333	28.1833	29.1223	(42b)
Hot water usage for other uses	41.1657	39.6688	38.1719	36.6749	35.1780	33.6810	33.6810	35.1780	36.6749	38.1719	39.6688	41.1657	(42c)
Average daily hot water use (litres/day)												126.9003	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.0513	135.1035	131.5137	126.0548	121.6219	116.8562	115.0246	118.5989	122.3686	127.3718	132.9148	137.6932	(44)
Energy conte	218.6395	192.3856	202.1316	172.5627	163.7265	143.6883	139.1123	146.8503	150.8927	172.8424	189.3615	215.5943	(45)
Energy content (annual)										Total = Sum(45)m =		2107.7876	
Distribution loss (46)m = 0.15 x (45)m	32.7959	28.8578	30.3197	25.8844	24.5590	21.5532	20.8668	22.0275	22.6339	25.9264	28.4042	32.3391	(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	14.8728	13.4182	14.8233	14.2760	14.7081	14.1894	14.6342	14.6575	14.2110	14.7354	14.3264	14.8637	(61)
Total heat required for water heating calculated for each month	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(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	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
									Total per year (kWh/year) = Sum(64)m =			2281.5036	(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	76.4158	67.3228	70.9146	60.9461	58.1161	51.3237	49.9134	52.4921	53.7246	61.1540	66.5443	75.4010	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	155.4676	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	35.1414	31.2123	25.3836	19.2170	14.3649	12.1275	13.1042	17.0333	22.8620	29.0286	33.8807	36.1181	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	350.0813	353.7140	344.5596	325.0709	300.4700	277.3486	261.9021	258.2694	267.4238	286.9124	311.5133	334.6347	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	53.1379	(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)	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	-103.6450	(71)
Water heating gains (Table 5)	102.7094	100.1827	95.3153	84.6474	78.1130	71.2829	67.0879	70.5539	74.6175	82.1962	92.4226	101.3455	(72)
Total internal gains	595.8926	593.0694	573.2189	536.8957	500.9084	465.7194	447.0546	450.8169	469.8637	506.0976	545.7771	580.0588	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.8000	9.8154	0.3000	0.0000	0.7700	4.0813	(74)
East	5.1600	18.1295	0.3000	0.0000	0.7700	21.6096	(76)
West	7.3200	18.1295	0.3000	0.0000	0.7700	30.6555	(80)

Solar gains	56.3464	112.5884	182.4190	269.8216	342.2204	348.6599	334.0326	280.5154	217.4423	135.0549	71.4442	50.2478	(83)
Total gains	652.2389	705.6578	755.6378	806.7173	843.1287	814.3793	781.0872	731.3323	687.3060	641.1526	617.2212	630.3066	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	59.5745	
alpha	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	4.9716	
util living area	0.9872	0.9800	0.9598	0.9057	0.7832	0.5833	0.4302	0.4690	0.7371	0.9298	0.9787	0.9895	(86)
MIT	19.9154	20.0477	20.3091	20.6161	20.8616	20.9755	20.9955	20.9933	20.9222	20.6053	20.1933	19.8607	(87)
Th 2	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	20.1101	(88)
util rest of house	0.9839	0.9749	0.9491	0.8809	0.7317	0.5021	0.3365	0.3704	0.6627	0.9061	0.9722	0.9867	(89)
MIT 2	19.1332	19.2634	19.5182	19.8075	20.0188	20.0993	20.1089	20.1082	20.0681	19.8039	19.4084	19.0792	(90)
Living area fraction										fLA = Living area / (4) =		0.1908	(91)
MIT	19.2824	19.4130	19.6691	19.9618	20.1796	20.2664	20.2781	20.2771	20.2311	19.9568	19.5581	19.2283	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1324	19.2630	19.5191	19.8118	20.0296	20.1164	20.1281	20.1271	20.0811	19.8068	19.4081	19.0783	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9790	0.9685	0.9404	0.8711	0.7266	0.5027	0.3385	0.3723	0.6601	0.8962	0.9655	0.9825	(94)
Useful gains	638.5737	683.4552	710.5887	702.7352	612.6486	409.3826	264.3738	272.2907	453.6821	574.5862	595.9565	619.2469	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W	1223.5375	1192.2204	1069.8108	891.1600	672.2467	416.8011	265.1898	273.5843	481.6230	763.5676	1018.0136	1235.9032	(97)
Space heating kWh	435.2130	341.8902	267.2613	135.6659	44.3410	0.0000	0.0000	0.0000	0.0000	140.6022	303.8811	458.7922	(98a)
Space heating requirement - total per year (kWh/year)												2127.6469	
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	435.2130	341.8902	267.2613	135.6659	44.3410	0.0000	0.0000	0.0000	0.0000	140.6022	303.8811	458.7922	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2127.6469	
Space heating per m2											(98c) / (4) =	24.2938	(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 %) 89.0000 (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	435.2130	341.8902	267.2613	135.6659	44.3410	0.0000	0.0000	0.0000	0.0000	140.6022	303.8811	458.7922	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	489.0034	384.1463	300.2936	152.4336	49.8214	0.0000	0.0000	0.0000	0.0000	157.9800	341.4394	515.4969	(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	233.5123	205.8038	216.9549	186.8387	178.4345	157.8776	153.7465	161.5077	165.1037	187.5778	203.6879	230.4580	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.3989	88.3535	88.2302	88.0072	87.6332	87.3000	87.3000	87.3000	87.3000	88.0203	88.3099	88.4243	(217)
Fuel for water heating, kWh/month	264.1574	232.9323	245.8964	212.2995	203.6153	180.8449	176.1128	185.0031	189.1223	213.1074	230.6512	260.6276	(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	10.8592	9.8083	10.8592	10.5089	10.8592	10.5089	10.8592	10.8592	10.5089	10.8592	10.5089	10.8592	(231)
Lighting	30.7591	24.6761	22.2181	16.2779	12.5735	10.2727	11.4700	14.9091	19.3655	25.4086	28.6989	31.6140	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.9116	-40.1033	-64.1285	-79.4666	-91.1737	-86.0803	-84.9733	-77.2606	-64.9106	-48.9769	-28.9748	-22.3228	(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	-9.7341	-24.6262	-57.4234	-102.0188	-153.1239	-157.3707	-154.9460	-120.1173	-77.8528	-38.5087	-13.9700	-8.2614	(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 2390.6145 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 87.3000
Water heating fuel used 2594.3704 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)
mechanical ventilation fans (SFP = 0.1567) 41.8583 (230a)
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 127.8583 (231)
Electricity for lighting (calculated in Appendix L) 248.2436 (232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1631.2365	(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	3729.8502	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2390.6145	4.8000	114.7495	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2594.3704	4.8000	124.5298	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	127.8583	21.5100	27.5023	(249)
Energy for lighting	248.2436	21.5100	53.3972	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-713.2831	21.5100	-153.4272	
PV Unit electricity exported	-917.9534	5.5900	-51.3136	
Total			-204.7408	(252)
Total energy cost			213.4380	(255)

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	2390.6145	0.2100	502.0290	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2594.3704	0.2100	544.8178	(264)
Space and water heating			1046.8468	(265)
Pumps, fans and electric keep-hot	127.8583	0.1387	17.7355	(267)
Energy for lighting	248.2436	0.1443	35.8292	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-713.2831	0.1328	-94.6961	
PV Unit electricity exported	-917.9534	0.1220	-111.9715	
Total			-206.6676	(269)
Total CO2, kg/year			893.7440	(272)

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	2390.6145	1.1300	2701.3943	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2594.3704	1.1300	2931.6385	(278)
Space and water heating			5633.0329	(279)
Pumps, fans and electric keep-hot	127.8583	1.5128	193.4240	(281)
Energy for lighting	248.2436	1.5338	380.7643	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-713.2831	1.4906	-1063.1943	
PV Unit electricity exported	-917.9534	0.4475	-410.8295	
Total			-1474.0238	(283)
Total Primary energy kWh/year			4733.1974	(286)

Full SAP Calculation Printout

Property Reference	HL0980A-Semi	**Issued on Date**	16/11/2023
Assessment Reference	001	**Prop Type Ref**	HT-HL980A (Semi)
Property	S63 0JF		

SAP Rating	91 B	**DER**	11.43	**TER**	11.72
Environmental	90 B	**% DER < TER**			2.47
CO_2 Emissions (t/year)	1.03	**DFEE**	36.11	**TFEE**	36.67
Compliance Check	See BREL	**% DFEE < TFEE**			1.53
% DPER < TPER	1.06	**DPER**	60.74	**TPER**	61.39

Assessor Details	Mr. Paul Goddard	**Assessor ID**	B342-0001
Client	Hoober Homes, Hoober Homes		

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	34.3800 (1b)	x	2.3100 (2b)	=	79.4178	(1b) - (3b)
First floor	34.3800 (1c)	x	2.6300 (2c)	=	90.4194	(1c) - (3c)
Second floor	27.3400 (1d)	x	2.7400 (2d)	=	74.9116	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.7488	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			11.5100	1.1450	13.1794			(27)
Patio Doors (Uw = 1.40)			3.8000	1.3258	5.0379			(27)
Rooflight			0.5400	1.7658	0.9535			(27a)
GF			34.3800	0.1100	3.7818	75.0000	2578.5000	(28a)
Main	99.4600	17.4600	82.0000	0.1800	14.7600	110.0000	9020.0000	(29a)
Dwarf (PIR x0.72)	15.9400		15.9400	0.1100	1.7534	9.0000	143.4600	(29a)
Dormer	1.8600		1.8600	0.1500	0.2790	9.0000	16.7400	(29a)
PIJ	13.2700		13.2700	0.1000	1.3270	9.0000	119.4300	(30)
PIR	19.7000	0.5400	19.1600	0.1500	2.8740	9.0000	172.4400	(30)
Residual (PIR x 0.72)	7.0400		7.0400	0.1100	0.7744	9.0000	63.3600	(30)
Total net area of external elements Aum(A, m2)			191.6500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8704			(33)
Party Wall 1			58.2400	0.0000	0.0000	70.0000	4076.8000	(32)

Internal Wall 1	150.1900	9.0000	1351.7100	(32c)
Internal Floor 1	34.3800	18.0000	618.8400	(32d)
Internal Floor 2	27.3400	18.0000	492.1200	(32d)
Internal Ceiling 1	34.3800	9.0000	309.4200	(32e)
Internal Ceiling 2	27.3400	9.0000	246.0600	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19208.8800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 199.8843 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	10.8800	0.0500	0.5440
E3 Sill	10.8800	0.0200	0.2176
E4 Jamb	22.2000	0.0160	0.3552
E5 Ground floor (normal)	16.5900	0.1080	1.7917
E6 Intermediate floor within a dwelling	32.2600	0.0000	0.0000
E16 Corner (normal)	20.8600	0.0510	1.0639
E18 Party wall between dwellings	15.3700	0.0290	0.4457
P1 Party wall - Ground floor	8.2400	0.0800	0.6592
E11 Eaves (insulation at rafter level)	8.3500	0.0070	0.0585
E12 Gable (insulation at ceiling level)	3.1800	0.0770	0.2449
P4 Party wall - Roof (insulation at ceiling level)	3.1800	0.0410	0.1304
E13 Gable (insulation at rafter level)	7.0800	0.0750	0.5310
E24 Eaves (insulation at ceiling level - inverted)	1.3100	0.1500	0.1965
E17 Corner (inverted - internal area greater than external area)	5.4900	-0.0700	-0.3843
P5 Party wall - Roof (insulation at rafter level)	7.0800	0.0180	0.1274
R7 Flat ceiling (inverted)	1.3100	0.1200	0.1572
R9 Roof to wall (flat ceiling)	2.3500	0.3200	0.7520
R1 Head of roof window	0.5500	0.2400	0.1320
R2 Sill of roof window	0.5500	0.2400	0.1320
R3 Jamb of roof window	1.9600	0.2400	0.4704

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.6252 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 54.4956 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.0746	41.6455	41.2165	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	(38)
Heat transfer coeff	96.5703	96.1412	95.7121	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	(39)
Average = Sum(39)m / 12 =												95.1947	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0049	1.0004	0.9960	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	(40)
HLP (average)												0.9906	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7004 (42)
Hot water usage for mixer showers

69.4961	68.4517	66.9298	64.0180	61.8691	59.4727	58.1106	59.6210	61.2766	63.8496	66.8240	69.2298	(42a)

Hot water usage for baths

30.0088	29.5632	28.9356	27.7784	26.9119	25.9511	25.4321	26.0553	26.7339	27.7620	28.9430	29.9074	(42b)

Hot water usage for other uses

42.2845	40.7469	39.2093	37.6716	36.1340	34.5964	34.5964	36.1340	37.6716	39.2093	40.7469	42.2845	(42c)

Average daily hot water use (litres/day) 130.3364 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.7894	138.7618	135.0746	129.4680	124.9150	120.0202	118.1391	121.8103	125.6821	130.8208	136.5139	141.4217	(44)
Energy conte	224.5598	197.5949	207.6047	177.2352	168.1596	147.5788	142.8790	150.8266	154.9786	177.5227	194.4890	221.4322	(45)
Energy content (annual)										Total = Sum(45)m =		2164.8613	
Distribution loss (46)m = 0.15 x (45)m	33.6840	29.6392	31.1407	26.5853	25.2239	22.1368	21.4319	22.6240	23.2468	26.6284	29.1734	33.2148	(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	14.8906	13.4339	14.8397	14.2900	14.7214	14.2010	14.6455	14.6694	14.2232	14.7495	14.3418	14.8812	(61)
Total heat required for water heating calculated for each month	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(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	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(64)
										Total per year (kWh/year) = Sum(64)m =		2338.7485	(64)
12Total per year (kWh/year)												2339	(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	78.3888	69.0588	72.7385	62.5032	59.5934	52.6202	51.1687	53.8172	55.0862	62.7137	68.2530	77.3465	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.5404	144.5269	130.5404	134.8917	130.5404	134.8917	130.5404	130.5404	134.8917	130.5404	134.8917	130.5404	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	249.8643	252.4571	245.9233	232.0137	214.4552	197.9527	186.9280	184.3352	190.8690	204.7787	222.3372	238.8396	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	(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)	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	(71)
Water heating gains (Table 5)	105.3613	102.7660	97.7668	86.8100	80.0987	73.0836	68.7751	72.3349	76.5086	84.2925	94.7959	103.9604	(72)
Total internal gains	552.2715	566.2556	540.7361	520.2210	491.5998	469.4336	449.7491	450.7161	465.7749	486.1172	518.5304	539.8460	(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	0.6000	10.6334	0.3000	0.0000	0.7700	1.4738	(74)
East	5.8000	19.6403	0.3000	0.0000	0.7700	26.3140	(76)
West	5.1100	19.6403	0.3000	0.0000	0.7700	23.1836	(80)
West	0.5400	26.2379	0.3000	0.7000	1.0000	2.6778	(82)
West	3.8000	19.6403	0.6300	0.7000	0.7700	22.8088	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	76.4580	149.6384	246.9284	361.3956	444.3420	455.5732	433.4276	371.2901	287.5563	177.6599	95.3390	62.8766	(83)
Total gains	628.7296	715.8939	787.6644	881.6166	935.9418	925.0069	883.1767	822.0062	753.3313	663.7771	613.8694	602.7225	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.2530	55.4996	55.7484	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	
alpha	4.6835	4.7000	4.7166	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	
util living area													
	0.9926	0.9855	0.9689	0.9152	0.8009	0.6229	0.4655	0.5183	0.7635	0.9445	0.9857	0.9938	(86)
MIT	19.6470	19.8461	20.1434	20.5312	20.8175	20.9574	20.9913	20.9857	20.8908	20.5057	20.0194	19.6330	(87)
Th 2	20.0793	20.0830	20.0867	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	(88)
util rest of house													
	0.9906	0.9818	0.9607	0.8932	0.7535	0.5468	0.3731	0.4221	0.6942	0.9254	0.9814	0.9923	(89)
MIT 2	18.8463	19.0462	19.3412	19.7167	19.9686	20.0726	20.0912	20.0891	20.0311	19.7003	19.2278	18.8437	(90)
Living area fraction										fLA = Living area / (4) =		0.1541	(91)
MIT	18.9697	19.1694	19.4648	19.8422	20.0994	20.2090	20.2299	20.2273	20.1636	19.8244	19.3498	18.9654	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8197	19.0194	19.3148	19.6922	19.9494	20.0590	20.0799	20.0773	20.0136	19.6744	19.1998	18.8154	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9870	0.9760	0.9519	0.8817	0.7451	0.5437	0.3717	0.4202	0.6873	0.9142	0.9755	0.9891	(94)
Useful gains	620.5408	698.7222	749.7494	777.2867	697.3481	502.8978	328.2331	345.4407	517.7849	606.8065	598.8497	596.1535	(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													
	1402.1687	1357.4595	1226.5305	1023.9564	782.7006	517.9438	330.1721	348.8953	561.0736	860.9706	1148.0162	1386.6944	(97)
Space heating kWh													
	581.5311	442.6715	354.7252	177.6022	63.5022	0.0000	0.0000	0.0000	0.0000	189.0981	395.3999	588.1625	(98a)
Space heating requirement - total per year (kWh/year)												2792.6927	
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													
	581.5311	442.6715	354.7252	177.6022	63.5022	0.0000	0.0000	0.0000	0.0000	189.0981	395.3999	588.1625	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2792.6927	
Space heating per m2											(98c) / (4) =	29.0603	(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 %)												89.0000	(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													
	581.5311	442.6715	354.7252	177.6022	63.5022	0.0000	0.0000	0.0000	0.0000	189.0981	395.3999	588.1625	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	653.4058	497.3837	398.5676	199.5530	71.3508	0.0000	0.0000	0.0000	0.0000	212.4698	444.2695	660.8567	(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													
	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4974	88.4440	88.3370	88.1098	87.7319	87.3000	87.3000	87.3000	87.3000	88.1347	88.4050	88.5060	(217)
Fuel for water heating, kWh/month													
	270.5735	238.6015	251.8133	217.3712	208.4544	185.3149	180.4405	189.5716	193.8166	218.1570	236.2205	267.0027	(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	11.2781	10.1867	11.2781	10.9143	11.2781	10.9143	11.2781	11.2781	10.9143	11.2781	10.9143	11.2781	(231)
Lighting	29.6363	23.7753	21.4070	15.6837	12.1146	9.8977	11.0513	14.3649	18.6586	24.4811	27.6513	30.4600	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.5073	-35.7805	-58.3858	-72.8622	-83.4894	-79.5991	-78.2563	-71.1247	-58.9126	-43.6269	-25.8828	-18.8545	(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	-7.8953	-19.1603	-45.2456	-78.7947	-113.6131	-117.8461	-115.0565	-91.5321	-59.4689	-29.4504	-11.0357	-5.9945	(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	3137.8569	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.3000	
Water heating fuel used	2657.3377	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)		
mechanical ventilation fans (SFP = 0.1567)	46.7904	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	132.7904	(231)
Electricity for lighting (calculated in Appendix L)	239.1817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1344.3752	(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	4822.7917	(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	3137.8569	0.2100	658.9500	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2657.3377	0.2100	558.0409	(264)
Space and water heating			1216.9909	(265)
Pumps, fans and electric keep-hot	132.7904	0.1387	18.4197	(267)
Energy for lighting	239.1817	0.1443	34.5213	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-649.2821	0.1326	-86.0730	
PV Unit electricity exported	-695.0930	0.1224	-85.0586	
Total			-171.1316	(269)
Total CO2, kg/year			1098.8003	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.4300	(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	3137.8569	1.1300	3545.7783	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2657.3377	1.1300	3002.7916	(278)
Space and water heating			6548.5700	(279)
Pumps, fans and electric keep-hot	132.7904	1.5128	200.8853	(281)
Energy for lighting	239.1817	1.5338	366.8649	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-649.2821	1.4898	-967.3220	
PV Unit electricity exported	-695.0930	0.4490	-312.1046	
Total			-1279.4267	(283)
Total Primary energy kWh/year			5836.8936	(286)
Dwelling Primary energy Rate (DPER)			60.7400	(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	34.3800 (1b)	x	2.3100 (2b)	=	79.4178	(1b) - (3b)
First floor	34.3800 (1c)	x	2.6300 (2c)	=	90.4194	(1c) - (3c)
Second floor	27.3400 (1d)	x	2.7400 (2d)	=	74.9116	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.7488	(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)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1226 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3726 (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) =	0.3167 (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	0.4038	0.3959	0.3879	0.3484	0.3404	0.3009	0.3009	0.2929	0.3167	0.3404	0.3563	0.3721	(22b)
Effective ac	0.5815	0.5784	0.5753	0.5607	0.5579	0.5453	0.5453	0.5429	0.5501	0.5579	0.5635	0.5692	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.20)			15.3100	1.1450	17.5305			(27)
Rooflight			0.5400	1.5038	0.8120			(27a)
GF			34.3800	0.1300	4.4694			(28a)
Main	99.4600	17.4600	82.0000	0.1800	14.7600			(29a)
Dwarf (PIR x0.72)	15.9400		15.9400	0.1800	2.8692			(29a)
Dormer	1.8600		1.8600	0.1800	0.3348			(29a)
PIJ	13.2700		13.2700	0.1100	1.4597			(30)
PIR	19.7000	0.5400	19.1600	0.1100	2.1076			(30)
Residual (PIR x 0.72)	7.0400		7.0400	0.1100	0.7744			(30)
Total net area of external elements Aum(A, m2)			191.6500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2677			(33)
Party Wall 1			58.2400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 199.8843 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	10.8800	0.0500	0.5440
E3	Sill	10.8800	0.0500	0.5440
E4	Jamb	22.2000	0.0500	1.1100
E5	Ground floor (normal)	16.5900	0.1600	2.6544
E6	Intermediate floor within a dwelling	32.2600	0.0000	0.0000
E16	Corner (normal)	20.8600	0.0900	1.8774
E18	Party wall between dwellings	15.3700	0.0600	0.9222
P1	Party wall - Ground floor	8.2400	0.0800	0.6592
E11	Eaves (insulation at rafter level)	8.3500	0.0400	0.3340
E12	Gable (insulation at ceiling level)	3.1800	0.0600	0.1908
P4	Party wall - Roof (insulation at ceiling level)	3.1800	0.1200	0.3816
E13	Gable (insulation at rafter level)	7.0800	0.0800	0.5664
E24	Eaves (insulation at ceiling level - inverted)	1.3100	0.2400	0.3144
E17	Corner (inverted - internal area greater than external area)	5.4900	-0.0900	-0.4941
P5	Party wall - Roof (insulation at rafter level)	7.0800	0.0800	0.5664
R7	Flat ceiling (inverted)	1.3100	0.0400	0.0524
R9	Roof to wall (flat ceiling)	2.3500	0.0400	0.0940
R1	Head of roof window	0.5500	0.0800	0.0440
R2	Sill of roof window	0.5500	0.0600	0.0330
R3	Jamb of roof window	1.9600	0.0800	0.1568

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.5509 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 57.8186 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.9675	46.7119	46.4613	45.2842	45.0640	44.0388	44.0388	43.8489	44.4337	45.0640	45.5095	45.9753	(38)
Heat transfer coeff	104.7861	104.5304	104.2798	103.1028	102.8825	101.8574	101.8574	101.6675	102.2522	102.8825	103.3281	103.7938	(39)
Average = Sum(39)m / 12 =												103.1017	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0904	1.0877	1.0851	1.0729	1.0706	1.0599	1.0599	1.0579	1.0640	1.0706	1.0752	1.0801	(40)
HLP (average)												1.0729	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7004 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
69.4961	68.4517	66.9298	64.0180	61.8691	59.4727	58.1106	59.6210	61.2766	63.8496	66.8240	69.2298	(42a)

Hot water usage for baths

30.0088	29.5632	28.9356	27.7784	26.9119	25.9511	25.4321	26.0553	26.7339	27.7620	28.9430	29.9074	(42b)

Hot water usage for other uses

42.2845	40.7469	39.2093	37.6716	36.1340	34.5964	34.5964	36.1340	37.6716	39.2093	40.7469	42.2845	(42c)

Average daily hot water use (litres/day) 130.3364 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.7894	138.7618	135.0746	129.4680	124.9150	120.0202	118.1391	121.8103	125.6821	130.8208	136.5139	141.4217	(44)
Energy conte	224.5598	197.5949	207.6047	177.2352	168.1596	147.5788	142.8790	150.8266	154.9786	177.5227	194.4890	221.4322	(45)
Energy content (annual)										Total = Sum(45)m =		2164.8613	

Distribution loss (46)m = 0.15 x (45)m

33.6840	29.6392	31.1407	26.5853	25.2239	22.1368	21.4319	22.6240	23.2468	26.6284	29.1734	33.2148	(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													
	275.5187	243.6223	258.5636	226.5503	219.1185	196.8939	193.8379	201.7855	204.2937	228.4816	243.8041	272.3911	(62)
WWHRS	-31.7707	-28.0983	-29.4229	-24.3633	-22.7057	-19.4295	-18.2120	-19.3667	-20.1025	-23.6986	-26.8476	-31.1824	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	243.7480	215.5240	229.1407	202.1870	196.4128	177.4644	175.6259	182.4188	184.1912	204.7830	216.9565	241.2088	(64)
										Total per year (kWh/year) = Sum(64)m =		2469.6610	(64)
12Total per year (kWh/year)												2470	(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													
	87.4059	77.2071	81.7683	71.2595	68.6528	61.3987	60.2470	62.8896	63.8592	71.7660	76.9964	86.3659	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	130.5404	144.5269	130.5404	134.8917	130.5404	134.8917	130.5404	130.5404	134.8917	130.5404	134.8917	130.5404	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.8643	252.4571	245.9233	232.0137	214.4552	197.9527	186.9280	184.3352	190.8690	204.7787	222.3372	238.8396	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	(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)													
	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	(71)
Water heating gains (Table 5)													
	117.4810	114.8916	109.9036	98.9715	92.2753	85.2760	80.9772	84.5290	88.6933	96.4597	106.9394	116.0833	(72)
Total internal gains													
	564.3913	578.3811	552.8729	532.3824	503.7764	481.6260	461.9511	462.9102	477.9596	498.2843	530.6739	551.9689	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6000	10.6334	0.6300	0.7000	0.7700	1.9498	(74)
East	5.8000	19.6403	0.6300	0.7000	0.7700	34.8135	(76)
West	8.9100	19.6403	0.6300	0.7000	0.7700	53.4807	(80)
West	0.5400	26.2379	0.6300	0.7000	1.0000	5.6235	(82)

Solar gains	95.8674	187.7362	310.1002	454.3702	559.1417	573.4954	545.5265	466.9895	361.2870	222.9694	119.5607	78.8263	(83)
Total gains	660.2587	766.1173	862.9731	986.7527	1062.9181	1055.1214	1007.4777	929.8996	839.2466	721.2538	650.2346	630.7951	(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	50.9209	51.0454	51.1681	51.7522	51.8630	52.3850	52.3850	52.4828	52.1827	51.8630	51.6394	51.4077	
alpha	4.3947	4.4030	4.4112	4.4501	4.4575	4.4923	4.4923	4.4989	4.4788	4.4575	4.4426	4.4272	
util living area													
	0.9914	0.9827	0.9620	0.8980	0.7714	0.5886	0.4383	0.4913	0.7403	0.9364	0.9836	0.9929	(86)
MIT	19.5291	19.7503	20.0833	20.5127	20.8154	20.9583	20.9911	20.9854	20.8863	20.4678	19.9266	19.4960	(87)
Th 2	20.0087	20.0109	20.0130	20.0231	20.0249	20.0337	20.0337	20.0353	20.0303	20.0249	20.0211	20.0172	(88)
util rest of house													
	0.9891	0.9783	0.9521	0.8722	0.7195	0.5104	0.3452	0.3937	0.6663	0.9145	0.9786	0.9910	(89)
MIT 2	18.2976	18.5797	18.9994	19.5280	19.8661	20.0078	20.0303	20.0292	19.9485	19.4883	18.8130	18.2615	(90)
Living area fraction										fLA = Living area / (4) =		0.1541	(91)
MIT	18.4874	18.7601	19.1665	19.6797	20.0124	20.1543	20.1783	20.1766	20.0930	19.6393	18.9846	18.4517	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4874	18.7601	19.1665	19.6797	20.0124	20.1543	20.1783	20.1766	20.0930	19.6393	18.9846	18.4517	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9841	0.9706	0.9411	0.8615	0.7187	0.5206	0.3594	0.4083	0.6715	0.9036	0.9712	0.9867	(94)
Useful gains	649.7618	743.5623	812.1372	850.1357	763.9430	549.2497	362.0562	379.7070	563.5817	651.7586	631.4960	622.4000	(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													
	1486.6440	1448.8028	1320.8571	1111.4200	855.2012	565.7452	364.4808	383.9541	612.8008	929.9831	1228.0110	1479.2402	(97)
Space heating kWh													
	622.6404	473.9217	378.4876	188.1247	67.8961	0.0000	0.0000	0.0000	0.0000	206.9991	429.4908	637.4891	(98a)
Space heating requirement - total per year (kWh/year)												3005.0494	
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													
	622.6404	473.9217	378.4876	188.1247	67.8961	0.0000	0.0000	0.0000	0.0000	206.9991	429.4908	637.4891	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3005.0494	
Space heating per m2											(98c) / (4) =	31.2700	(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													
	622.6404	473.9217	378.4876	188.1247	67.8961	0.0000	0.0000	0.0000	0.0000	206.9991	429.4908	637.4891	(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)													
	673.8532	512.9022	409.6187	203.5982	73.4806	0.0000	0.0000	0.0000	0.0000	224.0249	464.8168	689.9233	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	243.7480	215.5240	229.1407	202.1870	196.4128	177.4644	175.6259	182.4188	184.1912	204.7830	216.9565	241.2088	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.2997	86.0201	85.4489	84.2272	82.3463	80.3000	80.3000	80.3000	80.3000	84.4045	85.8155	86.3610	(217)
Fuel for water heating, kWh/month													
	282.4436	250.5508	268.1610	240.0495	238.5204	221.0018	218.7122	227.1717	229.3789	242.6208	252.8174	279.3027	(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	27.1237	21.7597	19.5922	14.3541	11.0875	9.0586	10.1144	13.1470	17.0767	22.4056	25.3070	27.8776	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-33.9819	-48.8776	-71.6525	-82.1990	-90.0100	-84.4797	-83.4128	-78.0600	-68.8568	-56.6022	-37.6923	-29.2649	(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	-16.3572	-34.7017	-69.5252	-105.2417	-139.9696	-140.9614	-139.3314	-117.6234	-85.7358	-49.9302	-21.9349	-12.9152	(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												3252.2180	(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												2950.7307	(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)												218.9039	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1699.3176	(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												4808.5350	(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	3252.2180	0.2100	682.9658	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2950.7307	0.2100	619.6534	(264)
Space and water heating			1302.6192	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	218.9039	0.1443	31.5946	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-765.0898	0.1342	-102.6573	
PV Unit electricity exported	-934.2278	0.1257	-117.3963	
Total			-220.0536	(269)
Total CO2, kg/year			1126.0894	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.7200	(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	3252.2180	1.1300	3675.0064	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2950.7307	1.1300	3334.3256	(278)
Space and water heating			7009.3320	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	218.9039	1.5338	335.7621	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-765.0898	1.4959	-1144.4765	
PV Unit electricity exported	-934.2278	0.4613	-430.9144	
Total			-1575.3908	(283)
Total Primary energy kWh/year			5899.8041	(286)
Target Primary Energy Rate (TPER)			61.3900	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	34.3800 (1b)	x	2.3100 (2b)	=	79.4178	(1b) - (3b)
First floor	34.3800 (1c)	x	2.6300 (2c)	=	90.4194	(1c) - (3c)
Second floor	27.3400 (1d)	x	2.7400 (2d)	=	74.9116	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.7488	(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)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1226 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3726 (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) =	0.3167 (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	0.4038	0.3959	0.3879	0.3484	0.3404	0.3009	0.3009	0.2929	0.3167	0.3404	0.3563	0.3721	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5815	0.5784	0.5753	0.5607	0.5579	0.5453	0.5453	0.5429	0.5501	0.5579	0.5635	0.5692	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			11.5100	1.1450	13.1794			(27)
Patio Doors (Uw = 1.40)			3.8000	1.3258	5.0379			(27)
Rooflight			0.5400	1.7658	0.9535			(27a)
GF			34.3800	0.1100	3.7818	75.0000	2578.5000	(28a)
Main	99.4600	17.4600	82.0000	0.1800	14.7600	110.0000	9020.0000	(29a)
Dwarf (PIR x0.72)	15.9400		15.9400	0.1100	1.7534	9.0000	143.4600	(29a)
Dormer	1.8600		1.8600	0.1500	0.2790	9.0000	16.7400	(29a)
PIJ	13.2700		13.2700	0.1000	1.3270	9.0000	119.4300	(30)
PIR	19.7000	0.5400	19.1600	0.1500	2.8740	9.0000	172.4400	(30)
Residual (PIR x 0.72)	7.0400		7.0400	0.1100	0.7744	9.0000	63.3600	(30)
Total net area of external elements Aum(A, m2)			191.6500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8704			(33)
Party Wall 1			58.2400	0.0000	0.0000	70.0000	4076.8000	(32)
Internal Wall 1			150.1900			9.0000	1351.7100	(32c)
Internal Floor 1			34.3800			18.0000	618.8400	(32d)
Internal Floor 2			27.3400			18.0000	492.1200	(32d)
Internal Ceiling 1			34.3800			9.0000	309.4200	(32e)
Internal Ceiling 2			27.3400			9.0000	246.0600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19208.8800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		199.8843 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	10.8800	0.0500	0.5440
E3 Sill	10.8800	0.0200	0.2176
E4 Jamb	22.2000	0.0160	0.3552
E5 Ground floor (normal)	16.5900	0.1080	1.7917
E6 Intermediate floor within a dwelling	32.2600	0.0000	0.0000
E16 Corner (normal)	20.8600	0.0510	1.0639
E18 Party wall between dwellings	15.3700	0.0290	0.4457
P1 Party wall - Ground floor	8.2400	0.0800	0.6592
E11 Eaves (insulation at rafter level)	8.3500	0.0070	0.0585
E12 Gable (insulation at ceiling level)	3.1800	0.0770	0.2449
P4 Party wall - Roof (insulation at ceiling level)	3.1800	0.0410	0.1304
E13 Gable (insulation at rafter level)	7.0800	0.0750	0.5310
E24 Eaves (insulation at ceiling level - inverted)	1.3100	0.1500	0.1965
E17 Corner (inverted - internal area greater than external area)	5.4900	-0.0700	-0.3843
P5 Party wall - Roof (insulation at rafter level)	7.0800	0.0180	0.1274
R7 Flat ceiling (inverted)	1.3100	0.1200	0.1572
R9 Roof to wall (flat ceiling)	2.3500	0.3200	0.7520
R1 Head of roof window	0.5500	0.2400	0.1320

R2 Sill of roof window										0.5500	0.2400	0.1320	
R3 Jamb of roof window										1.9600	0.2400	0.4704	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												7.6252	(36)
Point Thermal bridges											(36a) =	0.0000	
Total fabric heat loss										(33) + (36) + (36a) =		54.4956	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.9675	46.7119	46.4613	45.2842	45.0640	44.0388	44.0388	43.8489	44.4337	45.0640	45.5095	45.9753	(38)
Heat transfer coeff	101.4632	101.2075	100.9569	99.7798	99.5596	98.5344	98.5344	98.3446	98.9293	99.5596	100.0051	100.4709	(39)
Average = Sum(39)m / 12 =												99.7788	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0558	1.0531	1.0505	1.0383	1.0360	1.0253	1.0253	1.0234	1.0294	1.0360	1.0406	1.0455	(40)
HLP (average)												1.0383	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7004	(42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	30.0088	29.5632	28.9356	27.7784	26.9119	25.9511	25.4321	26.0553	26.7339	27.7620	28.9430	29.9074	(42b)
Hot water usage for other uses	42.2845	40.7469	39.2093	37.6716	36.1340	34.5964	34.5964	36.1340	37.6716	39.2093	40.7469	42.2845	(42c)
Average daily hot water use (litres/day)												66.2634	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	72.2933	70.3100	68.1448	65.4500	63.0459	60.5475	60.0285	62.1893	64.4055	66.9712	69.6899	72.1919	(44)
Energy conte	114.4949	100.1205	104.7360	89.5978	84.8719	74.4502	72.5993	77.0034	79.4185	90.8793	99.2860	113.0350	(45)
Energy content (annual)										Total = Sum(45)m =		1100.4929	
Distribution loss (46)m = 0.15 x (45)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	(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	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	97.3207	85.1025	89.0256	76.1581	72.1411	63.2827	61.7094	65.4529	67.5057	77.2474	84.3931	96.0798	(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	97.3207	85.1025	89.0256	76.1581	72.1411	63.2827	61.7094	65.4529	67.5057	77.2474	84.3931	96.0798	(64)
										Total per year (kWh/year) = Sum(64)m =		935.4190	(64)
12Total per year (kWh/year)												935	(64)
Electric shower(s)	55.6548	49.5889	54.1492	51.6739	52.6435	50.2168	51.8907	52.6435	51.6739	54.1492	53.1310	55.6548	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		633.0701	(64a)
Heat gains from water heating, kWh/month	38.2439	33.6728	35.7937	31.9580	31.1962	28.3749	28.4000	29.5241	29.7949	32.8491	34.3810	37.9336	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.5404	144.5269	130.5404	134.8917	130.5404	134.8917	130.5404	130.5404	134.8917	130.5404	134.8917	130.5404	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	249.8643	252.4571	245.9233	232.0137	214.4552	197.9527	186.9280	184.3352	190.8690	204.7787	222.3372	238.8396	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	(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)	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	(71)
Water heating gains (Table 5)	51.4031	50.1084	48.1098	44.3861	41.9303	39.4095	38.1721	39.6829	41.3818	44.1521	47.7514	50.9861	(72)
Total internal gains	495.3133	510.5979	488.0791	474.7971	450.4315	435.7595	419.1460	418.0641	430.6481	442.9767	468.4859	483.8717	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6000	10.6334	0.3000	0.0000	0.7700	1.4738	(74)
East	5.8000	19.6403	0.3000	0.0000	0.7700	26.3140	(76)
West	5.1100	19.6403	0.3000	0.0000	0.7700	23.1836	(80)
West	0.5400	26.2379	0.3000	0.7000	1.0000	2.6778	(82)
West	3.8000	19.6403	0.6300	0.7000	0.7700	22.8088	(80)

Solar gains	76.4580	149.6384	246.9284	361.3956	444.3420	455.5732	433.4276	371.2901	287.5563	177.6599	95.3390	62.8766	(83)
Total gains	571.7714	660.2363	735.0075	836.1927	894.7735	891.3328	852.5737	789.3542	718.2044	620.6366	563.8249	546.7482	(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, ni1,m (see Table 9a)													

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5885	52.7214	52.8522	53.4757	53.5940	54.1516	54.1516	54.2562	53.9355	53.5940	53.3553	53.1079	
alpha	4.5059	4.5148	4.5235	4.5650	4.5729	4.6101	4.6101	4.6171	4.5957	4.5729	4.5570	4.5405	
util living area	0.9950	0.9899	0.9774	0.9340	0.8343	0.6585	0.4972	0.5535	0.7998	0.9591	0.9902	0.9959	(86)
MIT	19.4771	19.6787	19.9901	20.4208	20.7562	20.9405	20.9869	20.9789	20.8527	20.4018	19.8707	19.4493	(87)
Th 2	20.0371	20.0393	20.0414	20.0515	20.0534	20.0623	20.0623	20.0639	20.0589	20.0534	20.0496	20.0456	(88)
util rest of house	0.9937	0.9872	0.9711	0.9153	0.7893	0.5790	0.3966	0.4498	0.7321	0.9437	0.9871	0.9949	(89)
MIT 2	18.6453	18.8472	19.1564	19.5797	19.8830	20.0321	20.0582	20.0567	19.9721	19.5703	19.0470	18.6242	(90)
Living area fraction										fLA = Living area / (4) =		0.1541	(91)
MIT	18.7735	18.9754	19.2849	19.7093	20.0176	20.1721	20.2013	20.1988	20.1078	19.6985	19.1739	18.7513	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7735	18.9754	19.2849	19.7093	20.0176	20.1721	20.2013	20.1988	20.1078	19.6985	19.1739	18.7513	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9912	0.9831	0.9647	0.9072	0.7874	0.5889	0.4119	0.4653	0.7360	0.9364	0.9832	0.9928	(94)
Useful gains	566.7647	649.0733	709.0690	758.5691	704.5456	524.8618	351.1822	367.2750	528.6112	581.1641	554.3377	542.7970	(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	1468.5264	1424.5322	1290.7231	1078.5542	828.0940	549.0435	354.8507	373.5926	594.3509	905.8408	1207.4568	1461.9862	(97)
Space heating kWh	670.9107	521.1083	432.7507	230.3893	91.9200	0.0000	0.0000	0.0000	0.0000	241.5595	470.2457	683.8768	(98a)
Space heating requirement - total per year (kWh/year)												3342.7609	
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	670.9107	521.1083	432.7507	230.3893	91.9200	0.0000	0.0000	0.0000	0.0000	241.5595	470.2457	683.8768	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3342.7609	
Space heating per m2											(98c) / (4) =	34.7842	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	926.2237	729.1548	747.4188	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8455	0.9087	0.8783	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	783.1398	662.6095	656.4823	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	983.5962	941.1029	870.2853	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	144.3286	207.1991	159.0694	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	36.0821	51.7998	39.7674	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												127.6493	(107)
Energy for space heating												34.7842	(99)
Energy for space cooling												1.3283	(108)
Total												36.1125	(109)
Fabric Energy Efficiency (DFEE)												36.1	(109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	34.3800 (1b)	x	2.3100 (2b)	=	79.4178	(1b) - (3b)
First floor	34.3800 (1c)	x	2.6300 (2c)	=	90.4194	(1c) - (3c)
Second floor	27.3400 (1d)	x	2.7400 (2d)	=	74.9116	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.7488	(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)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1226	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	

Measured/design AP50	5.0000	(17)
Infiltration rate	0.3726	(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) =	0.3167	(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	0.4038	0.3959	0.3879	0.3484	0.3404	0.3009	0.3009	0.2929	0.3167	0.3404	0.3563	0.3721	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5815	0.5784	0.5753	0.5607	0.5579	0.5453	0.5453	0.5429	0.5501	0.5579	0.5635	0.5692	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.20)			15.3100	1.1450	17.5305			(27)
Rooflight			0.5400	1.5038	0.8120			(27a)
GF			34.3800	0.1300	4.4694			(28a)
Main	99.4600	17.4600	82.0000	0.1800	14.7600			(29a)
Dwarf (PIR x0.72)	15.9400		15.9400	0.1800	2.8692			(29a)
Dormer	1.8600		1.8600	0.1800	0.3348			(29a)
PIJ	13.2700		13.2700	0.1100	1.4597			(30)
PIR	19.7000	0.5400	19.1600	0.1100	2.1076			(30)
Residual (PIR x 0.72)	7.0400		7.0400	0.1100	0.7744			(30)
Total net area of external elements Aum(A, m2)			191.6500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2677			(33)
Party Wall 1			58.2400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	199.8843	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	10.8800	0.0500	0.5440
E3 Sill	10.8800	0.0500	0.5440
E4 Jamb	22.2000	0.0500	1.1100
E5 Ground floor (normal)	16.5900	0.1600	2.6544
E6 Intermediate floor within a dwelling	32.2600	0.0000	0.0000
E16 Corner (normal)	20.8600	0.0900	1.8774
E18 Party wall between dwellings	15.3700	0.0600	0.9222
P1 Party wall - Ground floor	8.2400	0.0800	0.6592
E11 Eaves (insulation at rafter level)	8.3500	0.0400	0.3340
E12 Gable (insulation at ceiling level)	3.1800	0.0600	0.1908
P4 Party wall - Roof (insulation at ceiling level)	3.1800	0.1200	0.3816
E13 Gable (insulation at rafter level)	7.0800	0.0800	0.5664
E24 Eaves (insulation at ceiling level - inverted)	1.3100	0.2400	0.3144
E17 Corner (inverted - internal area greater than external area)	5.4900	-0.0900	-0.4941
P5 Party wall - Roof (insulation at rafter level)	7.0800	0.0800	0.5664
R7 Flat ceiling (inverted)	1.3100	0.0400	0.0524
R9 Roof to wall (flat ceiling)	2.3500	0.0400	0.0940
R1 Head of roof window	0.5500	0.0800	0.0440
R2 Sill of roof window	0.5500	0.0600	0.0330
R3 Jamb of roof window	1.9600	0.0800	0.1568

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.5509	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	57.8186	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.9675	46.7119	46.4613	45.2842	45.0640	44.0388	44.0388	43.8489	44.4337	45.0640	45.5095	45.9753	(38)
Heat transfer coeff	104.7861	104.5304	104.2798	103.1028	102.8825	101.8574	101.8574	101.6675	102.2522	102.8825	103.3281	103.7938	(39)

Average = Sum(39)m / 12 =	103.1017	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0904	1.0877	1.0851	1.0729	1.0706	1.0599	1.0599	1.0579	1.0640	1.0706	1.0752	1.0801	(40)
HLP (average)												1.0729	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7004	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

30.0088	29.5632	28.9356	27.7784	26.9119	25.9511	25.4321	26.0553	26.7339	27.7620	28.9430	29.9074	(42b)

Hot water usage for other uses

42.2845	40.7469	39.2093	37.6716	36.1340	34.5964	34.5964	36.1340	37.6716	39.2093	40.7469	42.2845	(42c)

Average daily hot water use (litres/day)	66.2634	(43)

Daily hot water use

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.2933	70.3100	68.1448	65.4500	63.0459	60.5475	60.0285	62.1893	64.4055	66.9712	69.6899	72.1919	(44)
Energy conte 114.4949	100.1205	104.7360	89.5978	84.8719	74.4502	72.5993	77.0034	79.4185	90.8793	99.2860	113.0350	(45)

Energy content (annual) Total = Sum(45)m =	1100.4929	

Distribution loss (46)m = 0.15 x (45)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	(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 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

97.3207	85.1025	89.0256	76.1581	72.1411	63.2827	61.7094	65.4529	67.5057	77.2474	84.3931	96.0798	(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	97.3207	85.1025	89.0256	76.1581	72.1411	63.2827	61.7094	65.4529	67.5057	77.2474	84.3931	96.0798	(64)
										Total per year (kWh/year) = Sum(64)m =		935.4190	(64)
12Total per year (kWh/year)												935	(64)
Electric shower(s)	55.6548	49.5889	54.1492	51.6739	52.6435	50.2168	51.8907	52.6435	51.6739	54.1492	53.1310	55.6548	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		633.0701	(64a)
Heat gains from water heating, kWh/month	38.2439	33.6728	35.7937	31.9580	31.1962	28.3749	28.4000	29.5241	29.7949	32.8491	34.3810	37.9336	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	135.0185	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.5404	144.5269	130.5404	134.8917	130.5404	134.8917	130.5404	130.5404	134.8917	130.5404	134.8917	130.5404	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	249.8643	252.4571	245.9233	232.0137	214.4552	197.9527	186.9280	184.3352	190.8690	204.7787	222.3372	238.8396	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	36.5019	(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)	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	(71)
Water heating gains (Table 5)	51.4031	50.1084	48.1098	44.3861	41.9303	39.4095	38.1721	39.6829	41.3818	44.1521	47.7514	50.9861	(72)
Total internal gains	495.3133	510.5979	488.0791	474.7971	450.4315	435.7595	419.1460	418.0641	430.6481	442.9767	468.4859	483.8717	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6000	10.6334	0.6300	0.7000	0.7700	1.9498	(74)
East	5.8000	19.6403	0.6300	0.7000	0.7700	34.8135	(76)
West	8.9100	19.6403	0.6300	0.7000	0.7700	53.4807	(80)
West	0.5400	26.2379	0.6300	0.7000	1.0000	5.6235	(82)

Solar gains	95.8674	187.7362	310.1002	454.3702	559.1417	573.4954	545.5265	466.9895	361.2870	222.9694	119.5607	78.8263	(83)
Total gains	591.1808	698.3341	798.1793	929.1673	1009.5732	1009.2549	964.6726	885.0536	791.9351	665.9461	588.0466	562.6979	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.9209	51.0454	51.1681	51.7522	51.8630	52.3850	52.3850	52.4828	52.1827	51.8630	51.6394	51.4077	
alpha	4.3947	4.4030	4.4112	4.4501	4.4575	4.4923	4.4923	4.4989	4.4788	4.4575	4.4426	4.4272	
util living area	0.9944	0.9877	0.9709	0.9140	0.7942	0.6106	0.4565	0.5138	0.7674	0.9507	0.9887	0.9955	(86)
MIT	19.4395	19.6655	20.0090	20.4630	20.7909	20.9518	20.9895	20.9826	20.8679	20.4108	19.8482	19.4070	(87)
Th 2	20.0087	20.0109	20.0130	20.0231	20.0249	20.0337	20.0337	20.0353	20.0303	20.0249	20.0211	20.0172	(88)
util rest of house	0.9929	0.9845	0.9630	0.8910	0.7440	0.5311	0.3601	0.4128	0.6951	0.9327	0.9852	0.9942	(89)
MIT 2	18.5865	18.8123	19.1519	19.5931	19.8829	20.0101	20.0305	20.0296	19.9548	19.5548	19.0028	18.5605	(90)
Living area fraction										fLA = Living area / (4) =		0.1541	(91)
MIT	18.7179	18.9438	19.2840	19.7272	20.0228	20.1552	20.1783	20.1764	20.0955	19.6867	19.1331	18.6910	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7179	18.9438	19.2840	19.7272	20.0228	20.1552	20.1783	20.1764	20.0955	19.6867	19.1331	18.6910	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9901	0.9797	0.9555	0.8828	0.7439	0.5416	0.3748	0.4280	0.7005	0.9248	0.9807	0.9919	(94)
Useful gains	585.3181	684.1808	762.6319	820.2680	751.0348	546.5646	361.6026	378.8126	554.7150	615.8422	576.7218	558.1429	(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	1510.7987	1468.0002	1333.1108	1116.3116	856.2718	565.8413	364.4781	383.9399	613.0525	934.8664	1243.3582	1504.0731	(97)
Space heating kWh	688.5575	526.7267	424.4363	213.1514	78.2963	0.0000	0.0000	0.0000	0.0000	237.3540	479.9782	703.7720	(98a)
Space heating requirement - total per year (kWh/year)												3352.2724	
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	688.5575	526.7267	424.4363	213.1514	78.2963	0.0000	0.0000	0.0000	0.0000	237.3540	479.9782	703.7720	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3352.2724	
Space heating per m2											(98c) / (4) =	34.8832	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	957.4592	753.7445	772.6731	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8751	0.9281	0.9003	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	837.9201	699.5192	695.6283	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1118.0336	1068.9139	979.4440	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													

	0.0000	0.0000	0.0000	0.0000	0.0000	201.6817	274.8296	211.1589	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	50.4204	68.7074	52.7897	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												171.9176 (107)
Energy for space heating												34.8832 (99)
Energy for space cooling												1.7889 (108)
Total												36.6721 (109)
Fabric Energy Efficiency (TFEE)												36.7 (109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	34.3800	(1b) x	2.3100	(2b) =	79.4178	(1b) - (3b)
First floor	34.3800	(1c) x	2.6300	(2c) =	90.4194	(1c) - (3c)
Second floor	27.3400	(1d) x	2.7400	(2d) =	74.9116	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.7488	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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													
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)
Mechanical extract ventilation - decentralised													
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)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			11.5100	1.1450	13.1794			(27)
Patio Doors (Uw = 1.40)			3.8000	1.3258	5.0379			(27)
Rooflight			0.5400	1.7658	0.9535			(27a)
GF			34.3800	0.1100	3.7818	75.0000	2578.5000	(28a)
Main	99.4600	17.4600	82.0000	0.1800	14.7600	110.0000	9020.0000	(29a)
Dwarf (PIR x0.72)	15.9400		15.9400	0.1100	1.7534	9.0000	143.4600	(29a)
Dormer	1.8600		1.8600	0.1500	0.2790	9.0000	16.7400	(29a)
PIJ	13.2700		13.2700	0.1000	1.3270	9.0000	119.4300	(30)
PIR	19.7000	0.5400	19.1600	0.1500	2.8740	9.0000	172.4400	(30)
Residual (PIR x 0.72)	7.0400		7.0400	0.1100	0.7744	9.0000	63.3600	(30)
Total net area of external elements Aum(A, m2)			191.6500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8704			(33)
Party Wall 1			58.2400	0.0000	0.0000	70.0000	4076.8000	(32)
Internal Wall 1			150.1900			9.0000	1351.7100	(32c)
Internal Floor 1			34.3800			18.0000	618.8400	(32d)
Internal Floor 2			27.3400			18.0000	492.1200	(32d)
Internal Ceiling 1			34.3800			9.0000	309.4200	(32e)
Internal Ceiling 2			27.3400			9.0000	246.0600	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		19208.8800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							199.8843	(35)

List of Thermal Bridges

		Length	Psi-value	Total
K1	Element			
E2	Other lintels (including other steel lintels)	10.8800	0.0500	0.5440
E3	Sill	10.8800	0.0200	0.2176

E4 Jamb	22.2000	0.0160	0.3552	
E5 Ground floor (normal)	16.5900	0.1080	1.7917	
E6 Intermediate floor within a dwelling	32.2600	0.0000	0.0000	
E16 Corner (normal)	20.8600	0.0510	1.0639	
E18 Party wall between dwellings	15.3700	0.0290	0.4457	
P1 Party wall - Ground floor	8.2400	0.0800	0.6592	
E11 Eaves (insulation at rafter level)	8.3500	0.0070	0.0585	
E12 Gable (insulation at ceiling level)	3.1800	0.0770	0.2449	
P4 Party wall - Roof (insulation at ceiling level)	3.1800	0.0410	0.1304	
E13 Gable (insulation at rafter level)	7.0800	0.0750	0.5310	
E24 Eaves (insulation at ceiling level - inverted)	1.3100	0.1500	0.1965	
E17 Corner (inverted - internal area greater than external area)	5.4900	-0.0700	-0.3843	
P5 Party wall - Roof (insulation at rafter level)	7.0800	0.0180	0.1274	
R7 Flat ceiling (inverted)	1.3100	0.1200	0.1572	
R9 Roof to wall (flat ceiling)	2.3500	0.3200	0.7520	
R1 Head of roof window	0.5500	0.2400	0.1320	
R2 Sill of roof window	0.5500	0.2400	0.1320	
R3 Jamb of roof window	1.9600	0.2400	0.4704	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.6252 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 54.4956 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.0746	41.6455	41.2165	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	(38)
Heat transfer coeff	96.5703	96.1412	95.7121	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	(39)

Average = Sum(39)m / 12 = 95.1947

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0049	1.0004	0.9960	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	(40)
HLP (average)												0.9906	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7004 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.4961	68.4517	66.9298	64.0180	61.8691	59.4727	58.1106	59.6210	61.2766	63.8496	66.8240	69.2298	(42a)
Hot water usage for baths	30.0088	29.5632	28.9356	27.7784	26.9119	25.9511	25.4321	26.0553	26.7339	27.7620	28.9430	29.9074	(42b)
Hot water usage for other uses	42.2845	40.7469	39.2093	37.6716	36.1340	34.5964	34.5964	36.1340	37.6716	39.2093	40.7469	42.2845	(42c)

Average daily hot water use (litres/day) 130.3364 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.7894	138.7618	135.0746	129.4680	124.9150	120.0202	118.1391	121.8103	125.6821	130.8208	136.5139	141.4217	(44)
Energy conte	224.5598	197.5949	207.6047	177.2352	168.1596	147.5788	142.8790	150.8266	154.9786	177.5227	194.4890	221.4322	(45)

Energy content (annual) Total = Sum(45)m = 2164.8613

Distribution loss (46)m = 0.15 x (45)m	33.6840	29.6392	31.1407	26.5853	25.2239	22.1368	21.4319	22.6240	23.2468	26.6284	29.1734	33.2148	(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	14.8906	13.4339	14.8397	14.2900	14.7214	14.2010	14.6455	14.6694	14.2232	14.7495	14.3418	14.8812	(61)
Total heat required for water heating calculated for each month	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(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	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(64)

Total per year (kWh/year) = Sum(64)m = 2338.7485 (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	78.3888	69.0588	72.7385	62.5032	59.5934	52.6202	51.1687	53.8172	55.0862	62.7137	68.2530	77.3465	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.8586	30.0730	24.4570	18.5155	13.8406	11.6848	12.6258	16.4115	22.0275	27.9690	32.6439	34.7997	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	372.9318	376.8017	367.0498	346.2890	320.0824	295.4518	278.9970	275.1272	284.8791	305.6398	331.8465	356.4771	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	(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)	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	(71)
Water heating gains (Table 5)	105.3613	102.7660	97.7668	86.8100	80.0987	73.0836	68.7751	72.3349	76.5086	84.2925	94.7959	103.9604	(72)
Total internal gains	623.0617	620.5507	600.1835	562.5246	524.9316	488.1302	468.3079	471.7836	491.3252	528.8113	570.1963	606.1471	(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	0.6000	10.6334	0.3000	0.0000	0.7700	1.4738	(74)
East	5.8000	19.6403	0.3000	0.0000	0.7700	26.3140	(76)

West			5.1100		19.6403		0.3000		0.0000		0.7700		23.1836 (80)
West			0.5400		26.2379		0.3000		0.7000		1.0000		2.6778 (82)
West			3.8000		19.6403		0.6300		0.7000		0.7700		22.8088 (80)
Solar gains	76.4580	149.6384	246.9284	361.3956	444.3420	455.5732	433.4276	371.2901	287.5563	177.6599	95.3390	62.8766 (83)	
Total gains	699.5198	770.1890	847.1119	923.9202	969.2736	943.7035	901.7356	843.0737	778.8816	706.4712	665.5353	669.0237 (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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.2530	55.4996	55.7484	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	
alpha	4.6835	4.7000	4.7166	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	
util living area	0.9886	0.9807	0.9596	0.9024	0.7851	0.6128	0.4565	0.5065	0.7475	0.9319	0.9804	0.9905 (86)	
MIT	19.7393	19.9143	20.2116	20.5682	20.8333	20.9602	20.9920	20.9870	20.9005	20.5489	20.0845	19.7205 (87)	
Th 2	20.0793	20.0830	20.0867	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939 (88)	
util rest of house	0.9857	0.9760	0.9495	0.8782	0.7365	0.5371	0.3656	0.4119	0.6772	0.9096	0.9746	0.9882 (89)	
MIT 2	18.9375	19.1131	19.4064	19.7496	19.9805	20.0742	20.0914	20.0896	20.0373	19.7392	19.2913	18.9304 (90)	
Living area fraction										fLA = Living area / (4) =		0.1541 (91)	
MIT	19.0611	19.2365	19.5305	19.8757	20.1119	20.2107	20.2302	20.2279	20.1703	19.8640	19.4135	19.0521 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	18.9111	19.0865	19.3805	19.7257	19.9619	20.0607	20.0802	20.0779	20.0203	19.7140	19.2635	18.9021 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9808	0.9691	0.9396	0.8667	0.7287	0.5342	0.3642	0.4102	0.6709	0.8980	0.9676	0.9839 (94)	
Useful gains	686.0808	746.4229	795.9713	800.8007	706.2754	504.1154	328.4220	345.8332	522.5746	634.4264	643.9961	658.2427 (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	1410.9976	1363.9113	1232.8205	1027.1365	783.8835	518.1069	330.2003	348.9525	561.7160	864.7294	1154.0664	1394.9264 (97)	
Space heating kWh	539.3381	414.9522	325.0159	162.9617	57.7404	0.0000	0.0000	0.0000	0.0000	171.3454	367.2506	548.0926 (98a)	
Space heating requirement - total per year (kWh/year)												2586.6971	
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	539.3381	414.9522	325.0159	162.9617	57.7404	0.0000	0.0000	0.0000	0.0000	171.3454	367.2506	548.0926 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												2586.6971	
Space heating per m2											(98c) / (4) =	26.9167 (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 %)												89.0000 (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	539.3381	414.9522	325.0159	162.9617	57.7404	0.0000	0.0000	0.0000	0.0000	171.3454	367.2506	548.0926 (98)	
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000 (210)	
Space heating fuel (main heating system)	605.9979	466.2385	365.1864	183.1031	64.8769	0.0000	0.0000	0.0000	0.0000	192.5229	412.6412	615.8344 (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	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134 (64)	
Efficiency of water heater												87.3000 (216)	
(217)m	88.4703	88.4196	88.3013	88.0734	87.7020	87.3000	87.3000	87.3000	87.3000	88.0929	88.3761	88.4809 (217)	
Fuel for water heating, kWh/month	270.6562	238.6675	251.9151	217.4610	208.5255	185.3149	180.4405	189.5716	193.8166	218.2606	236.2977	267.0784 (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	11.2781	10.1867	11.2781	10.9143	11.2781	10.9143	11.2781	11.2781	10.9143	11.2781	10.9143	11.2781 (231)	
Lighting	29.6363	23.7753	21.4070	15.6837	12.1146	9.8977	11.0513	14.3649	18.6586	24.4811	27.6513	30.4600 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.5073	-35.7805	-58.3858	-72.8622	-83.4894	-79.5991	-78.2563	-71.1247	-58.9126	-43.6269	-25.8828	-18.8545 (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	-7.8953	-19.1603	-45.2456	-78.7947	-113.6131	-117.8461	-115.0565	-91.5321	-59.4689	-29.4504	-11.0357	-5.9945 (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												2906.4012 (211)	
Space heating fuel - main system 2												0.0000 (213)	
Space heating fuel - secondary												0.0000 (215)	
Efficiency of water heater												87.3000	
Water heating fuel used												2658.0056 (219)	

Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)		
mechanical ventilation fans (SFP = 0.1567)	46.7904	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	132.7904	(231)
Electricity for lighting (calculated in Appendix L)	239.1817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1344.3752	(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	4592.0038	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2906.4012	3.6400	105.7930	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2658.0056	3.6400	96.7514	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	132.7904	16.4900	21.8971	(249)
Energy for lighting	239.1817	16.4900	39.4411	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-649.2821	16.4900	-107.0666	
PV Unit electricity exported	-695.0930	5.5900	-38.8557	
Total			-145.9223	(252)
Total energy cost			209.9603	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5357	(257)
SAP value		91.3165	
SAP rating (Section 12)		91	(258)
SAP band		B	

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	2906.4012	0.2100	610.3443	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2658.0056	0.2100	558.1812	(264)
Space and water heating			1168.5254	(265)
Pumps, fans and electric keep-hot	132.7904	0.1387	18.4197	(267)
Energy for lighting	239.1817	0.1443	34.5213	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-649.2821	0.1326	-86.0730	
PV Unit electricity exported	-695.0930	0.1224	-85.0586	
Total			-171.1316	(269)
Total CO2, kg/year			1050.3348	(272)
CO2 emissions per m2			10.9300	(273)
EI value			90.0252	
EI rating			90	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	34.3800 (1b)	x	2.3100 (2b)	=	79.4178	(1b) - (3b)
First floor	34.3800 (1c)	x	2.6300 (2c)	=	90.4194	(1c) - (3c)
Second floor	27.3400 (1d)	x	2.7400 (2d)	=	74.9116	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.7488	(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	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
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		5.0000 (17)
Infiltration rate		0.2500 (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) =	0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			11.5100	1.1450	13.1794			(27)
Patio Doors (Uw = 1.40)			3.8000	1.3258	5.0379			(27)
Rooflight			0.5400	1.7658	0.9535			(27a)
GF			34.3800	0.1100	3.7818	75.0000	2578.5000	(28a)
Main	99.4600	17.4600	82.0000	0.1800	14.7600	110.0000	9020.0000	(29a)
Dwarf (PIR x0.72)	15.9400		15.9400	0.1100	1.7534	9.0000	143.4600	(29a)
Dormer	1.8600		1.8600	0.1500	0.2790	9.0000	16.7400	(29a)
PIJ	13.2700		13.2700	0.1000	1.3270	9.0000	119.4300	(30)
PIR	19.7000	0.5400	19.1600	0.1500	2.8740	9.0000	172.4400	(30)
Residual (PIR x 0.72)	7.0400		7.0400	0.1100	0.7744	9.0000	63.3600	(30)
Total net area of external elements Aum(A, m2)			191.6500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8704			(33)
Party Wall 1			58.2400	0.0000	0.0000	70.0000	4076.8000	(32)
Internal Wall 1			150.1900			9.0000	1351.7100	(32c)
Internal Floor 1			34.3800			18.0000	618.8400	(32d)
Internal Floor 2			27.3400			18.0000	492.1200	(32d)
Internal Ceiling 1			34.3800			9.0000	309.4200	(32e)
Internal Ceiling 2			27.3400			9.0000	246.0600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19208.8800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		199.8843 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	10.8800	0.0500	0.5440
E3 Sill	10.8800	0.0200	0.2176
E4 Jamb	22.2000	0.0160	0.3552
E5 Ground floor (normal)	16.5900	0.1080	1.7917
E6 Intermediate floor within a dwelling	32.2600	0.0000	0.0000
E16 Corner (normal)	20.8600	0.0510	1.0639
E18 Party wall between dwellings	15.3700	0.0290	0.4457
P1 Party wall - Ground floor	8.2400	0.0800	0.6592
E11 Eaves (insulation at rafter level)	8.3500	0.0070	0.0585
E12 Gable (insulation at ceiling level)	3.1800	0.0770	0.2449
P4 Party wall - Roof (insulation at ceiling level)	3.1800	0.0410	0.1304
E13 Gable (insulation at rafter level)	7.0800	0.0750	0.5310
E24 Eaves (insulation at ceiling level - inverted)	1.3100	0.1500	0.1965
E17 Corner (inverted - internal area greater than external area)	5.4900	-0.0700	-0.3843
P5 Party wall - Roof (insulation at rafter level)	7.0800	0.0180	0.1274
R7 Flat ceiling (inverted)	1.3100	0.1200	0.1572
R9 Roof to wall (flat ceiling)	2.3500	0.3200	0.7520
R1 Head of roof window	0.5500	0.2400	0.1320
R2 Sill of roof window	0.5500	0.2400	0.1320
R3 Jamb of roof window	1.9600	0.2400	0.4704

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.6252 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	54.4956 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	(38)
Heat transfer coeff	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	(39)
Average = Sum(39)m / 12 =												94.8792	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	(40)
HLP (average)												0.9873	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7004 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.4961	68.4517	66.9298	64.0180	61.8691	59.4727	58.1106	59.6210	61.2766	63.8496	66.8240	69.2298	(42a)
Hot water usage for baths	30.0088	29.5632	28.9356	27.7784	26.9119	25.9511	25.4321	26.0553	26.7339	27.7620	28.9430	29.9074	(42b)
Hot water usage for other uses	42.2845	40.7469	39.2093	37.6716	36.1340	34.5964	34.5964	36.1340	37.6716	39.2093	40.7469	42.2845	(42c)

Average daily hot water use (litres/day) 130.3364 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.7894	138.7618	135.0746	129.4680	124.9150	120.0202	118.1391	121.8103	125.6821	130.8208	136.5139	141.4217	(44)
Energy conte	224.5598	197.5949	207.6047	177.2352	168.1596	147.5788	142.8790	150.8266	154.9786	177.5227	194.4890	221.4322	(45)
Energy content (annual)										Total = Sum(45)m =		2164.8613	
Distribution loss (46)m = 0.15 x (45)m	33.6840	29.6392	31.1407	26.5853	25.2239	22.1368	21.4319	22.6240	23.2468	26.6284	29.1734	33.2148	(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	14.8906	13.4339	14.8397	14.2900	14.7214	14.2010	14.6455	14.6694	14.2232	14.7495	14.3418	14.8812	(61)
Total heat required for water heating calculated for each month	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(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	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(64)
									Total per year (kWh/year) = Sum(64)m =			2338.7485	(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	78.3888	69.0588	72.7385	62.5032	59.5934	52.6202	51.1687	53.8172	55.0862	62.7137	68.2530	77.3465	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.8586	30.0730	24.4570	18.5155	13.8406	11.6848	12.6258	16.4115	22.0275	27.9690	32.6439	34.7997	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	372.9318	376.8017	367.0498	346.2890	320.0824	295.4518	278.9970	275.1272	284.8791	305.6398	331.8465	356.4771	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	(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)	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	(71)
Water heating gains (Table 5)	105.3613	102.7660	97.7668	86.8100	80.0987	73.0836	68.7751	72.3349	76.5086	84.2925	94.7959	103.9604	(72)
Total internal gains	623.0617	620.5507	600.1835	562.5246	524.9316	488.1302	468.3079	471.7836	491.3252	528.8113	570.1963	606.1471	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6000	9.8154	0.3000	0.0000	0.7700	1.3604	(74)
East	5.8000	18.1295	0.3000	0.0000	0.7700	24.2899	(76)
West	5.1100	18.1295	0.3000	0.0000	0.7700	21.4002	(80)
West	0.5400	24.2196	0.3000	0.7000	1.0000	2.4719	(82)
West	3.8000	18.1295	0.6300	0.7000	0.7700	21.0543	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	70.5767	141.3251	228.9232	337.3026	425.8278	432.7946	415.0815	350.0059	272.5534	169.5845	89.5609	62.8766	(83)
Total gains	693.6384	761.8758	829.1067	899.8271	950.7594	920.9248	883.3894	821.7896	763.8786	698.3958	659.7572	669.0237	(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	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	
alpha	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	
util living area	0.9876	0.9798	0.9581	0.9003	0.7738	0.5756	0.4251	0.4661	0.7353	0.9302	0.9794	0.9898	(86)
MIT	19.8164	19.9660	20.2534	20.5879	20.8506	20.9722	20.9946	20.9918	20.9114	20.5629	20.1149	19.7589	(87)
Th 2	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	(88)
util rest of house	0.9845	0.9748	0.9474	0.8749	0.7219	0.4943	0.3311	0.3667	0.6610	0.9069	0.9732	0.9872	(89)
MIT 2	19.0255	19.1728	19.4532	19.7685	19.9948	20.0815	20.0925	20.0916	20.0454	19.7526	19.3214	18.9686	(90)
Living area fraction										fLA = Living area / (4) =		0.1541	(91)
MIT	19.1474	19.2950	19.5765	19.8948	20.1267	20.2187	20.2315	20.2304	20.1788	19.8775	19.4437	19.0904	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9974	19.1450	19.4265	19.7448	19.9767	20.0687	20.0815	20.0804	20.0288	19.7275	19.2937	18.9404	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9794	0.9678	0.9374	0.8634	0.7145	0.4920	0.3298	0.3652	0.6551	0.8953	0.9660	0.9827	(94)
Useful gains	679.3159	737.3517	777.2242	776.9011	679.3292	453.0806	291.3446	300.1055	500.3983	625.2594	637.3153	657.4601	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W	1356.5216	1323.0906	1188.5037	990.9913	747.3363	461.9404	292.3714	301.7494	534.0589	847.0345	1128.4612	1370.0943	(97)
Space heating kWh	503.8411	393.6165	305.9919	154.1450	50.5973	0.0000	0.0000	0.0000	0.0000	165.0007	353.6251	530.1999	(98a)
Space heating requirement - total per year (kWh/year)												2457.0174	
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	(98b)
Solar heating contribution - total per year (kWh/year)											0.0000	
Space heating kWh												
	503.8411	393.6165	305.9919	154.1450	50.5973	0.0000	0.0000	0.0000	0.0000	165.0007	353.6251	530.1999 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)											2457.0174	
Space heating per m2										(98c) / (4) =	25.5673	(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 %)											89.0000	(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													
	503.8411	393.6165	305.9919	154.1450	50.5973	0.0000	0.0000	0.0000	0.0000	165.0007	353.6251	530.1999	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	566.1135	442.2658	343.8111	173.1966	56.8509	0.0000	0.0000	0.0000	0.0000	185.3941	397.3315	595.7302	(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													
	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4452	88.3992	88.2764	88.0500	87.6629	87.3000	87.3000	87.3000	87.3000	88.0770	88.3611	88.4689	(217)
Fuel for water heating, kWh/month													
	270.7332	238.7224	251.9863	217.5187	208.6186	185.3149	180.4405	189.5716	193.8166	218.3001	236.3378	267.1148	(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	11.2781	10.1867	11.2781	10.9143	11.2781	10.9143	11.2781	11.2781	10.9143	11.2781	10.9143	11.2781	(231)
Lighting	29.6363	23.7753	21.4070	15.6837	12.1146	9.8977	11.0513	14.3649	18.6586	24.4811	27.6513	30.4600	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-21.0279	-34.2124	-55.3201	-69.7537	-81.5030	-77.4174	-76.4400	-68.7160	-56.9014	-42.1516	-24.5872	-18.8545	(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	-7.0361	-17.6761	-40.7549	-71.7927	-107.3869	-110.1556	-108.6902	-84.6165	-55.3037	-27.6040	-10.0938	-5.9945	(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												2760.6937	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2658.4755	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)													
mechanical ventilation fans (SFP = 0.1567)												46.7904	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												132.7904	(231)
Electricity for lighting (calculated in Appendix L)												239.1817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1273.9900	(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												4517.1514	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2760.6937	4.8000	132.5133	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2658.4755	4.8000	127.6068	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	132.7904	21.5100	28.5632	(249)
Energy for lighting	239.1817	21.5100	51.4480	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-626.8851	21.5100	-134.8430	
PV Unit electricity exported	-647.1049	5.5900	-36.1732	
Total			-171.0162	(252)
Total energy cost			267.1152	(255)

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	2760.6937	0.2100	579.7457	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2658.4755	0.2100	558.2799	(264)
Space and water heating			1138.0255	(265)
Pumps, fans and electric keep-hot	132.7904	0.1387	18.4197	(267)
Energy for lighting	239.1817	0.1443	34.5213	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-626.8851	0.1324	-83.0303	
PV Unit electricity exported	-647.1049	0.1221	-79.0317	
Total			-162.0620	(269)
Total CO2, kg/year			1028.9045	(272)

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	2760.6937	1.1300	3119.5839	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2658.4755	1.1300	3004.0773	(278)
Space and water heating			6123.6612	(279)
Pumps, fans and electric keep-hot	132.7904	1.5128	200.8853	(281)
Energy for lighting	239.1817	1.5338	366.8649	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-626.8851	1.4894	-933.6772	
PV Unit electricity exported	-647.1049	0.4481	-289.9761	
Total			-1223.6533	(283)
Total Primary energy kWh/year			5467.7582	(286)

SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating: B 91
Current environmental impact rating: B 90

N	Solar water heating	SAP increase too small
U	Solar photovoltaic panels	Already installed
V2	Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
(none)			

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.5	-£ 15	-124 kg (12.1%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 91
Potential environmental impact rating: B 90

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, East Pennines):

	Current	Potential	Saving
Electricity	£80	£80	£0
Mains gas	£358	£358	£0
Space heating	£259	£259	£0
Water heating	£128	£128	£0
Lighting	£51	£51	£0
Generated (PV)	-£171	-£171	£0
Total cost of fuels	£267	£267	£0
Total cost of uses	£267	£267	£0
Delivered energy	47 kWh/m²	47 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.0 tonnes	1.0 tonnes	0.0 tonnes
CO2 emissions per m²	11 kg/m²	11 kg/m²	0 kg/m²
Primary energy	57 kWh/m²	57 kWh/m²	0 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	34.3800 (1b)	x	2.3100 (2b)	=	79.4178 (1b) - (3b)	
First floor	34.3800 (1c)	x	2.6300 (2c)	=	90.4194 (1c) - (3c)	
Second floor	27.3400 (1d)	x	2.7400 (2d)	=	74.9116 (1d) - (3d)	

Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 96.1000 (4)
Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 244.7488 (5)

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2. Ventilation rate
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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised
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)

Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			11.5100	1.1450	13.1794			(27)
Patio Doors (Uw = 1.40)			3.8000	1.3258	5.0379			(27)
Rooflight			0.5400	1.7658	0.9535			(27a)
GF			34.3800	0.1100	3.7818	75.0000	2578.5000	(28a)
Main	99.4600	17.4600	82.0000	0.1800	14.7600	110.0000	9020.0000	(29a)
Dwarf (PIR x0.72)	15.9400		15.9400	0.1100	1.7534	9.0000	143.4600	(29a)
Dormer	1.8600		1.8600	0.1500	0.2790	9.0000	16.7400	(29a)
PIJ	13.2700		13.2700	0.1000	1.3270	9.0000	119.4300	(30)
PIR	19.7000	0.5400	19.1600	0.1500	2.8740	9.0000	172.4400	(30)
Residual (PIR x 0.72)	7.0400		7.0400	0.1100	0.7744	9.0000	63.3600	(30)
Total net area of external elements Aum(A, m2)			191.6500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8704			(33)
Party Wall 1			58.2400	0.0000	0.0000	70.0000	4076.8000	(32)
Internal Wall 1			150.1900			9.0000	1351.7100	(32c)
Internal Floor 1			34.3800			18.0000	618.8400	(32d)
Internal Floor 2			27.3400			18.0000	492.1200	(32d)
Internal Ceiling 1			34.3800			9.0000	309.4200	(32e)
Internal Ceiling 2			27.3400			9.0000	246.0600	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19208.8800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 199.8843 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	10.8800	0.0500	0.5440
E3	Sill	10.8800	0.0200	0.2176
E4	Jamb	22.2000	0.0160	0.3552
E5	Ground floor (normal)	16.5900	0.1080	1.7917
E6	Intermediate floor within a dwelling	32.2600	0.0000	0.0000
E16	Corner (normal)	20.8600	0.0510	1.0639
E18	Party wall between dwellings	15.3700	0.0290	0.4457
P1	Party wall - Ground floor	8.2400	0.0800	0.6592
E11	Eaves (insulation at rafter level)	8.3500	0.0070	0.0585
E12	Gable (insulation at ceiling level)	3.1800	0.0770	0.2449
P4	Party wall - Roof (insulation at ceiling level)	3.1800	0.0410	0.1304
E13	Gable (insulation at rafter level)	7.0800	0.0750	0.5310
E24	Eaves (insulation at ceiling level - inverted)	1.3100	0.1500	0.1965
E17	Corner (inverted - internal area greater than external area)	5.4900	-0.0700	-0.3843
P5	Party wall - Roof (insulation at rafter level)	7.0800	0.0180	0.1274
R7	Flat ceiling (inverted)	1.3100	0.1200	0.1572
R9	Roof to wall (flat ceiling)	2.3500	0.3200	0.7520
R1	Head of roof window	0.5500	0.2400	0.1320
R2	Sill of roof window	0.5500	0.2400	0.1320
R3	Jamb of roof window	1.9600	0.2400	0.4704

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.6252 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 54.4956 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.0746	41.6455	41.2165	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	(38)
Heat transfer coeff	96.5703	96.1412	95.7121	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	(39)

Average = Sum(39)m / 12 = 95.1947

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0049	1.0004	0.9960	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	(40)
HLP (average)												0.9906	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7004 (42)

Hot water usage for mixer showers

	69.4961	68.4517	66.9298	64.0180	61.8691	59.4727	58.1106	59.6210	61.2766	63.8496	66.8240	69.2298 (42a)

Hot water usage for baths

	30.0088	29.5632	28.9356	27.7784	26.9119	25.9511	25.4321	26.0553	26.7339	27.7620	28.9430	29.9074 (42b)

Hot water usage for other uses

	42.2845	40.7469	39.2093	37.6716	36.1340	34.5964	34.5964	36.1340	37.6716	39.2093	40.7469	42.2845 (42c)

Average daily hot water use (litres/day) 130.3364 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.7894	138.7618	135.0746	129.4680	124.9150	120.0202	118.1391	121.8103	125.6821	130.8208	136.5139	141.4217	(44)
Energy conte	224.5598	197.5949	207.6047	177.2352	168.1596	147.5788	142.8790	150.8266	154.9786	177.5227	194.4890	221.4322	(45)

Energy content (annual) Total = Sum(45)m = 2164.8613

Distribution loss (46)m = 0.15 x (45)m

	33.6840	29.6392	31.1407	26.5853	25.2239	22.1368	21.4319	22.6240	23.2468	26.6284	29.1734	33.2148 (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	14.8906	13.4339	14.8397	14.2900	14.7214	14.2010	14.6455	14.6694	14.2232	14.7495	14.3418	14.8812 (61)

Total heat required for water heating calculated for each month

	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134 (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

	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134 (64)

Total per year (kWh/year) = Sum(64)m = 2338.7485 (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

	78.3888	69.0588	72.7385	62.5032	59.5934	52.6202	51.1687	53.8172	55.0862	62.7137	68.2530	77.3465 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	33.8586	30.0730	24.4570	18.5155	13.8406	11.6848	12.6258	16.4115	22.0275	27.9690	32.6439	34.7997 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	372.9318	376.8017	367.0498	346.2890	320.0824	295.4518	278.9970	275.1272	284.8791	305.6398	331.8465	356.4771 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026 (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)

	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148 (71)

Water heating gains (Table 5)

	105.3613	102.7660	97.7668	86.8100	80.0987	73.0836	68.7751	72.3349	76.5086	84.2925	94.7959	103.9604 (72)

Total internal gains

	623.0617	620.5507	600.1835	562.5246	524.9316	488.1302	468.3079	471.7836	491.3252	528.8113	570.1963	606.1471 (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	0.6000	10.6334	0.3000	0.0000	0.7700	1.4738	(74)
East	5.8000	19.6403	0.3000	0.0000	0.7700	26.3140	(76)
West	5.1100	19.6403	0.3000	0.0000	0.7700	23.1836	(80)
West	0.5400	26.2379	0.3000	0.7000	1.0000	2.6778	(82)
West	3.8000	19.6403	0.6300	0.7000	0.7700	22.8088	(80)

Solar gains	76.4580	149.6384	246.9284	361.3956	444.3420	455.5732	433.4276	371.2901	287.5563	177.6599	95.3390	62.8766	(83)
Total gains	699.5198	770.1890	847.1119	923.9202	969.2736	943.7035	901.7356	843.0737	778.8816	706.4712	665.5353	669.0237	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.2530	55.4996	55.7484	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	
alpha	4.6835	4.7000	4.7166	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	
util living area	0.9886	0.9807	0.9596	0.9024	0.7851	0.6128	0.4565	0.5065	0.7475	0.9319	0.9804	0.9905	(86)
MIT	19.7393	19.9143	20.2116	20.5682	20.8333	20.9602	20.9920	20.9870	20.9005	20.5489	20.0845	19.7205	(87)
Th 2	20.0793	20.0830	20.0867	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	(88)
util rest of house	0.9857	0.9760	0.9495	0.8782	0.7365	0.5371	0.3656	0.4119	0.6772	0.9096	0.9746	0.9882	(89)
MIT 2	18.9375	19.1131	19.4064	19.7496	19.9805	20.0742	20.0914	20.0896	20.0373	19.7392	19.2913	18.9304	(90)

Living area fraction fLA = Living area / (4) = 0.1541 (91)

MIT	19.0611	19.2365	19.5305	19.8757	20.1119	20.2107	20.2302	20.2279	20.1703	19.8640	19.4135	19.0521	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9111	19.0865	19.3805	19.7257	19.9619	20.0607	20.0802	20.0779	20.0203	19.7140	19.2635	18.9021	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9808	0.9691	0.9396	0.8667	0.7287	0.5342	0.3642	0.4102	0.6709	0.8980	0.9676	0.9839	(94)
Useful gains	686.0808	746.4229	795.9713	800.8007	706.2754	504.1154	328.4220	345.8332	522.5746	634.4264	643.9961	658.2427	(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	1410.9976	1363.9113	1232.8205	1027.1365	783.8835	518.1069	330.2003	348.9525	561.7160	864.7294	1154.0664	1394.9264	(97)
Space heating kWh	539.3381	414.9522	325.0159	162.9617	57.7404	0.0000	0.0000	0.0000	0.0000	171.3454	367.2506	548.0926	(98a)
Space heating requirement - total per year (kWh/year)												2586.6971	
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	539.3381	414.9522	325.0159	162.9617	57.7404	0.0000	0.0000	0.0000	0.0000	171.3454	367.2506	548.0926	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2586.6971	
Space heating per m2											(98c) / (4) =	26.9167	(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 %)	89.0000	(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	539.3381	414.9522	325.0159	162.9617	57.7404	0.0000	0.0000	0.0000	0.0000	171.3454	367.2506	548.0926	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	605.9979	466.2385	365.1864	183.1031	64.8769	0.0000	0.0000	0.0000	0.0000	192.5229	412.6412	615.8344	(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	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4703	88.4196	88.3013	88.0734	87.7020	87.3000	87.3000	87.3000	87.3000	88.0929	88.3761	88.4809	(217)
Fuel for water heating, kWh/month	270.6562	238.6675	251.9151	217.4610	208.5255	185.3149	180.4405	189.5716	193.8166	218.2606	236.2977	267.0784	(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	11.2781	10.1867	11.2781	10.9143	11.2781	10.9143	11.2781	11.2781	10.9143	11.2781	10.9143	11.2781	(231)
Lighting	29.6363	23.7753	21.4070	15.6837	12.1146	9.8977	11.0513	14.3649	18.6586	24.4811	27.6513	30.4600	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.5073	-35.7805	-58.3858	-72.8622	-83.4894	-79.5991	-78.2563	-71.1247	-58.9126	-43.6269	-25.8828	-18.8545	(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	-7.8953	-19.1603	-45.2456	-78.7947	-113.6131	-117.8461	-115.0565	-91.5321	-59.4689	-29.4504	-11.0357	-5.9945	(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	2906.4012	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.3000	
Water heating fuel used	2658.0056	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)		
mechanical ventilation fans (SFP = 0.1567)	46.7904	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	132.7904	(231)
Electricity for lighting (calculated in Appendix L)	239.1817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1344.3752	(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	4592.0038	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2906.4012	3.6400	105.7930	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2658.0056	3.6400	96.7514	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	132.7904	16.4900	21.8971	(249)
Energy for lighting	239.1817	16.4900	39.4411	(250)
Additional standing charges			92.0000	(251)

Energy saving/generation technologies				
PV Unit electricity used in dwelling	-649.2821	16.4900	-107.0666	
PV Unit electricity exported	-695.0930	5.5900	-38.8557	
Total			-145.9223	(252)
Total energy cost			209.9603	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5357	(257)
SAP value		91.3165	
SAP rating (Section 12)		91	(258)
SAP band		B	

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	2906.4012	0.2100	610.3443	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2658.0056	0.2100	558.1812	(264)
Space and water heating			1168.5254	(265)
Pumps, fans and electric keep-hot	132.7904	0.1387	18.4197	(267)
Energy for lighting	239.1817	0.1443	34.5213	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-649.2821	0.1326	-86.0730	
PV Unit electricity exported	-695.0930	0.1224	-85.0586	
Total			-171.1316	(269)
Total CO2, kg/year			1050.3348	(272)
CO2 emissions per m2			10.9300	(273)
EI value			90.0252	
EI rating			90	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	34.3800 (1b)	x	2.3100 (2b)	=	79.4178	(1b) - (3b)
First floor	34.3800 (1c)	x	2.6300 (2c)	=	90.4194	(1c) - (3c)
Second floor	27.3400 (1d)	x	2.7400 (2d)	=	74.9116	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		244.7488	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)
Mechanical extract ventilation - decentralised													
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)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			11.5100	1.1450	13.1794			(27)
Patio Doors (Uw = 1.40)			3.8000	1.3258	5.0379			(27)
Rooflight			0.5400	1.7658	0.9535			(27a)
GF			34.3800	0.1100	3.7818	75.0000	2578.5000	(28a)
Main	99.4600	17.4600	82.0000	0.1800	14.7600	110.0000	9020.0000	(29a)
Dwarf (PIR x0.72)	15.9400		15.9400	0.1100	1.7534	9.0000	143.4600	(29a)
Dormer	1.8600		1.8600	0.1500	0.2790	9.0000	16.7400	(29a)
PIJ	13.2700		13.2700	0.1000	1.3270	9.0000	119.4300	(30)
PIR	19.7000	0.5400	19.1600	0.1500	2.8740	9.0000	172.4400	(30)
Residual (PIR x 0.72)	7.0400		7.0400	0.1100	0.7744	9.0000	63.3600	(30)
Total net area of external elements Aum(A, m2)			191.6500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8704			(33)
Party Wall 1			58.2400	0.0000	0.0000	70.0000	4076.8000	(32)
Internal Wall 1			150.1900			9.0000	1351.7100	(32c)
Internal Floor 1			34.3800			18.0000	618.8400	(32d)
Internal Floor 2			27.3400			18.0000	492.1200	(32d)
Internal Ceiling 1			34.3800			9.0000	309.4200	(32e)
Internal Ceiling 2			27.3400			9.0000	246.0600	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19208.8800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 199.8843 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	10.8800	0.0500	0.5440
E3	Sill	10.8800	0.0200	0.2176
E4	Jamb	22.2000	0.0160	0.3552
E5	Ground floor (normal)	16.5900	0.1080	1.7917
E6	Intermediate floor within a dwelling	32.2600	0.0000	0.0000
E16	Corner (normal)	20.8600	0.0510	1.0639
E18	Party wall between dwellings	15.3700	0.0290	0.4457
P1	Party wall - Ground floor	8.2400	0.0800	0.6592
E11	Eaves (insulation at rafter level)	8.3500	0.0070	0.0585
E12	Gable (insulation at ceiling level)	3.1800	0.0770	0.2449
P4	Party wall - Roof (insulation at ceiling level)	3.1800	0.0410	0.1304
E13	Gable (insulation at rafter level)	7.0800	0.0750	0.5310
E24	Eaves (insulation at ceiling level - inverted)	1.3100	0.1500	0.1965
E17	Corner (inverted - internal area greater than external area)	5.4900	-0.0700	-0.3843
P5	Party wall - Roof (insulation at rafter level)	7.0800	0.0180	0.1274
R7	Flat ceiling (inverted)	1.3100	0.1200	0.1572
R9	Roof to wall (flat ceiling)	2.3500	0.3200	0.7520
R1	Head of roof window	0.5500	0.2400	0.1320
R2	Sill of roof window	0.5500	0.2400	0.1320
R3	Jamb of roof window	1.9600	0.2400	0.4704

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.6252 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 54.4956 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	40.3836	(38)
Heat transfer coeff	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	94.8792	(39)
Average = Sum(39)m / 12 =												94.8792	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	0.9873	(40)
HLP (average)												0.9873	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7004 (42)
Hot water usage for mixer showers

69.4961	68.4517	66.9298	64.0180	61.8691	59.4727	58.1106	59.6210	61.2766	63.8496	66.8240	69.2298	(42a)

Hot water usage for baths

30.0088	29.5632	28.9356	27.7784	26.9119	25.9511	25.4321	26.0553	26.7339	27.7620	28.9430	29.9074	(42b)

Hot water usage for other uses

42.2845	40.7469	39.2093	37.6716	36.1340	34.5964	34.5964	36.1340	37.6716	39.2093	40.7469	42.2845	(42c)

Average daily hot water use (litres/day) 130.3364 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.7894	138.7618	135.0746	129.4680	124.9150	120.0202	118.1391	121.8103	125.6821	130.8208	136.5139	141.4217	(44)
Energy conte	224.5598	197.5949	207.6047	177.2352	168.1596	147.5788	142.8790	150.8266	154.9786	177.5227	194.4890	221.4322	(45)
Energy content (annual)										Total = Sum(45)m =		2164.8613	
Distribution loss (46)m = 0.15 x (45)m	33.6840	29.6392	31.1407	26.5853	25.2239	22.1368	21.4319	22.6240	23.2468	26.6284	29.1734	33.2148	(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	14.8906	13.4339	14.8397	14.2900	14.7214	14.2010	14.6455	14.6694	14.2232	14.7495	14.3418	14.8812	(61)
Total heat required for water heating calculated for each month	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(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	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(64)
									Total per year (kWh/year) = Sum(64)m =			2338.7485	(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	78.3888	69.0588	72.7385	62.5032	59.5934	52.6202	51.1687	53.8172	55.0862	62.7137	68.2530	77.3465	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	162.0222	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.8586	30.0730	24.4570	18.5155	13.8406	11.6848	12.6258	16.4115	22.0275	27.9690	32.6439	34.7997	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	372.9318	376.8017	367.0498	346.2890	320.0824	295.4518	278.9970	275.1272	284.8791	305.6398	331.8465	356.4771	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	53.9026	(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)													
	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	-108.0148	(71)
Water heating gains (Table 5)													
	105.3613	102.7660	97.7668	86.8100	80.0987	73.0836	68.7751	72.3349	76.5086	84.2925	94.7959	103.9604	(72)
Total internal gains													
	623.0617	620.5507	600.1835	562.5246	524.9316	488.1302	468.3079	471.7836	491.3252	528.8113	570.1963	606.1471	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6000	9.8154	0.3000	0.0000	0.7700	1.3604	(74)
East	5.8000	18.1295	0.3000	0.0000	0.7700	24.2899	(76)
West	5.1100	18.1295	0.3000	0.0000	0.7700	21.4002	(80)
West	0.5400	24.2196	0.3000	0.7000	1.0000	2.4719	(82)
West	3.8000	18.1295	0.6300	0.7000	0.7700	21.0543	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	70.5767	141.3251	228.9232	337.3026	425.8278	432.7946	415.0815	350.0059	272.5534	169.5845	89.5609	62.8766	(83)
Total gains	693.6384	761.8758	829.1067	899.8271	950.7594	920.9248	883.3894	821.7896	763.8786	698.3958	659.7572	669.0237	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	56.2378	
alpha	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	4.7492	
util living area													
	0.9876	0.9798	0.9581	0.9003	0.7738	0.5756	0.4251	0.4661	0.7353	0.9302	0.9794	0.9898	(86)
MIT	19.8164	19.9660	20.2534	20.5879	20.8506	20.9722	20.9946	20.9918	20.9114	20.5629	20.1149	19.7589	(87)
Th 2	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	20.0939	(88)
util rest of house													
	0.9845	0.9748	0.9474	0.8749	0.7219	0.4943	0.3311	0.3667	0.6610	0.9069	0.9732	0.9872	(89)
MIT 2	19.0255	19.1728	19.4532	19.7685	19.9948	20.0815	20.0925	20.0916	20.0454	19.7526	19.3214	18.9686	(90)
Living area fraction									fLA = Living area / (4) =			0.1541	(91)
MIT	19.1474	19.2950	19.5765	19.8948	20.1267	20.2187	20.2315	20.2304	20.1788	19.8775	19.4437	19.0904	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9974	19.1450	19.4265	19.7448	19.9767	20.0687	20.0815	20.0804	20.0288	19.7275	19.2937	18.9404	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9794	0.9678	0.9374	0.8634	0.7145	0.4920	0.3298	0.3652	0.6551	0.8953	0.9660	0.9827	(94)
Useful gains	679.3159	737.3517	777.2242	776.9011	679.3292	453.0806	291.3446	300.1055	500.3983	625.2594	637.3153	657.4601	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W													
	1356.5216	1323.0906	1188.5037	990.9913	747.3363	461.9404	292.3714	301.7494	534.0589	847.0345	1128.4612	1370.0943	(97)
Space heating kWh													
	503.8411	393.6165	305.9919	154.1450	50.5973	0.0000	0.0000	0.0000	0.0000	165.0007	353.6251	530.1999	(98a)
Space heating requirement - total per year (kWh/year)												2457.0174	
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													
	503.8411	393.6165	305.9919	154.1450	50.5973	0.0000	0.0000	0.0000	0.0000	165.0007	353.6251	530.1999	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2457.0174	
Space heating per m2											(98c) / (4) =	25.5673	(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 %)	89.0000	(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													
	503.8411	393.6165	305.9919	154.1450	50.5973	0.0000	0.0000	0.0000	0.0000	165.0007	353.6251	530.1999	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	566.1135	442.2658	343.8111	173.1966	56.8509	0.0000	0.0000	0.0000	0.0000	185.3941	397.3315	595.7302	(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

	239.4504	211.0287	222.4444	191.5252	182.8810	161.7799	157.5246	165.4960	169.2019	192.2721	208.8308	236.3134	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.4452	88.3992	88.2764	88.0500	87.6629	87.3000	87.3000	87.3000	87.3000	88.0770	88.3611	88.4689	(217)
Fuel for water heating, kWh/month													
	270.7332	238.7224	251.9863	217.5187	208.6186	185.3149	180.4405	189.5716	193.8166	218.3001	236.3378	267.1148	(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	11.2781	10.1867	11.2781	10.9143	11.2781	10.9143	11.2781	11.2781	10.9143	11.2781	10.9143	11.2781	(231)
Lighting	29.6363	23.7753	21.4070	15.6837	12.1146	9.8977	11.0513	14.3649	18.6586	24.4811	27.6513	30.4600	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-21.0279	-34.2124	-55.3201	-69.7537	-81.5030	-77.4174	-76.4400	-68.7160	-56.9014	-42.1516	-24.5872	-18.8545	(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	-7.0361	-17.6761	-40.7549	-71.7927	-107.3869	-110.1556	-108.6902	-84.6165	-55.3037	-27.6040	-10.0938	-5.9945	(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	2760.6937	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.3000	
Water heating fuel used	2658.4755	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)		
mechanical ventilation fans (SFP = 0.1567)	46.7904	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	132.7904	(231)
Electricity for lighting (calculated in Appendix L)	239.1817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1273.9900	(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	4517.1514	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2760.6937	4.8000	132.5133	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2658.4755	4.8000	127.6068	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	132.7904	21.5100	28.5632	(249)
Energy for lighting	239.1817	21.5100	51.4480	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-626.8851	21.5100	-134.8430	
PV Unit electricity exported	-647.1049	5.5900	-36.1732	
Total			-171.0162	(252)
Total energy cost			267.1152	(255)

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	2760.6937	0.2100	579.7457	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2658.4755	0.2100	558.2799	(264)
Space and water heating			1138.0255	(265)
Pumps, fans and electric keep-hot	132.7904	0.1387	18.4197	(267)
Energy for lighting	239.1817	0.1443	34.5213	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-626.8851	0.1324	-83.0303	
PV Unit electricity exported	-647.1049	0.1221	-79.0317	
Total			-162.0620	(269)
Total CO2, kg/year			1028.9045	(272)

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	2760.6937	1.1300	3119.5839	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2658.4755	1.1300	3004.0773	(278)
Space and water heating			6123.6612	(279)
Pumps, fans and electric keep-hot	132.7904	1.5128	200.8853	(281)
Energy for lighting	239.1817	1.5338	366.8649	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-626.8851	1.4894	-933.6772	
PV Unit electricity exported	-647.1049	0.4481	-289.9761	
Total			-1223.6533	(283)
Total Primary energy kWh/year			5467.7582	(286)

Full SAP Calculation Printout

Property Reference	HL1280-Det	**Issued on Date**	16/11/2023
Assessment Reference	001	**Prop Type Ref**	HT-HL1280 (Det)
Property	S63 0JF		

SAP Rating	96 A	**DER**	9.69	**TER**	10.21
Environmental	91 B	**% DER < TER**			5.09
CO_2 Emissions (t/year)	1.15	**DFEE**	39.47	**TFEE**	39.65
Compliance Check	See BREL	**% DFEE < TFEE**			0.44
% DPER < TPER	4.00	**DPER**	51.27	**TPER**	53.41

Assessor Details	Mr. Paul Goddard	**Assessor ID**	B342-0001
Client	Hoober Homes, Hoober Homes		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.2300 (1b)	x	2.3100 (2b)	=	146.0613	(1b) - (3b)
First floor	63.2300 (1c)	x	2.6800 (2c)	=	169.4564	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 126.4600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	315.5177	(5)

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2. Ventilation rate

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			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		0 * 10 =	0.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
		Air changes per hour		
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			5.0000	(17)
Infiltration rate			0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			4.0500	1.0000	4.0500			(26)
Window (Uw = 1.20)			19.2500	1.1450	22.0420			(27)
GF			63.2300	0.1100	6.9553	75.0000	4742.2500	(28a)
Main	167.8137	23.3000	144.5137	0.1800	26.0125	110.0000	15896.5070	(29a)
PIJ	63.2300		63.2300	0.1000	6.3230	9.0000	569.0700	(30)
Total net area of external elements Aum(A, m2)			294.2737					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.3828			(33)
Internal Wall 1			134.1400			9.0000	1207.2600	(32c)
Internal Floor 1			63.2300			18.0000	1138.1400	(32d)
Internal Ceiling 1			63.2300			9.0000	569.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	24122.2970 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		190.7504 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	18.4200	0.0500	0.9210	
E3 Sill	18.4200	0.0200	0.3684	
E4 Jamb	36.3000	0.0160	0.5808	
E5 Ground floor (normal)	33.6300	0.1080	3.6320	
E6 Intermediate floor within a dwelling	33.6300	0.0000	0.0000	
E16 Corner (normal)	29.9400	0.0510	1.5269	
E17 Corner (inverted - internal area greater than external area)	9.9800	-0.0700	-0.6986	
E10 Eaves (insulation at ceiling level)	18.9300	0.1220	2.3095	
E12 Gable (insulation at ceiling level)	14.7100	0.0770	1.1327	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.7727 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 75.1555 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2405	53.6873	53.1342	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	(38)
Heat transfer coeff	129.3959	128.8428	128.2896	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	(39)

Average = Sum(39)m / 12 = 127.6226

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0232	1.0188	1.0145	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	(40)
HLP (average)												1.0092	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8852 (42)

Hot water usage for mixer showers

	72.5949	71.5039	69.9142	66.8725	64.6278	62.1246	60.7017	62.2794	64.0089	66.6966	69.8036	72.3167	(42a)

Hot water usage for baths

	31.3414	30.8759	30.2205	29.0119	28.1069	27.1035	26.5615	27.2123	27.9210	28.9948	30.2282	31.2354	(42b)

Hot water usage for other uses

	44.1772	42.5707	40.9643	39.3578	37.7514	36.1450	36.1450	37.7514	39.3578	40.9643	42.5707	44.1772	(42c)

Average daily hot water use (litres/day) 136.1495 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.1135	144.9506	141.0989	135.2422	130.4862	125.3730	123.4081	127.2432	131.2878	136.6557	142.6026	147.7294	(44)
Energy conte	234.5755	206.4077	216.8638	185.1399	175.6594	154.1607	149.2514	157.5536	161.8909	185.4405	203.1636	231.3085	(45)

Energy content (annual) Total = Sum(45)m = 2261.4156

Distribution loss (46)m = 0.15 x (45)m

	35.1863	30.9612	32.5296	27.7710	26.3489	23.1241	22.3877	23.6330	24.2836	27.8161	30.4745	34.6963	(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	14.9206	13.4603	14.8675	14.3137	14.7439	14.2208	14.6647	14.6896	14.2440	14.7732	14.3678	14.9108	(61)

Total heat required for water heating calculated for each month

	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(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

	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)

Total per year (kWh/year) = Sum(64)m = 2435.5925 (64)

12Total per year (kWh/year) 2436 (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

	81.7265	71.9956	75.8241	65.1374	62.0927	54.8136	53.2923	56.0590	57.3897	65.3523	71.1438	80.6378	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	155.9581	172.6679	155.9581	161.1567	155.9581	161.1567	155.9581	155.9581	161.1567	155.9581	161.1567	155.9581	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	293.4013	296.4459	288.7736	272.4403	251.8224	232.4445	219.4988	216.4542	224.1265	240.4598	261.0777	280.4557	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	(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)	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	(71)
Water heating gains (Table 5)	109.8475	107.1364	101.9141	90.4687	83.4580	76.1300	71.6294	75.3481	79.7080	87.8391	98.8109	108.3841	(72)
Total internal gains	628.4847	645.5280	615.9236	593.3435	560.5163	536.0090	513.3641	514.0382	531.2690	553.5348	590.3231	614.0757	(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	2.7500	10.6334	0.3000	0.0000	0.7700	6.7549	(74)
East	9.4500	19.6403	0.3000	0.0000	0.7700	42.8737	(76)
South	5.6100	46.7521	0.3000	0.0000	0.7700	60.5865	(78)
West	1.4400	19.6403	0.3000	0.0000	0.7700	6.5331	(80)

Solar gains	116.7482	208.7842	307.4997	410.2265	480.8206	485.3018	464.6759	411.7357	343.5284	237.0735	141.7532	98.6133	(83)
Total gains	745.2329	854.3122	923.4233	1003.5700	1041.3369	1021.3109	978.0400	925.7739	874.7974	790.6083	732.0763	712.6889	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
tau	51.7840	52.0063	52.2306	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	
alpha	4.4523	4.4671	4.4820	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	
util living area	0.9943	0.9887	0.9777	0.9442	0.8666	0.7157	0.5516	0.6002	0.8200	0.9581	0.9889	0.9953	(86)
MIT	19.4755	19.6785	19.9701	20.3622	20.6975	20.9102	20.9782	20.9682	20.8270	20.3904	19.8743	19.4609	(87)
Th 2	20.0640	20.0677	20.0713	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	(88)
util rest of house	0.9928	0.9859	0.9718	0.9284	0.8280	0.6384	0.4454	0.4937	0.7571	0.9432	0.9856	0.9941	(89)
MIT 2	18.6684	18.8726	19.1636	19.5499	19.8588	20.0299	20.0710	20.0666	19.9724	19.5824	19.0765	18.6647	(90)
Living area fraction										fLA = Living area / (4) =		0.1827	(91)
MIT	18.8158	19.0198	19.3109	19.6982	20.0120	20.1907	20.2367	20.2313	20.1285	19.7300	19.2222	18.8101	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6658	18.8698	19.1609	19.5482	19.8620	20.0407	20.0867	20.0813	19.9785	19.5800	19.0722	18.6601	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9897	0.9808	0.9640	0.9172	0.8174	0.6349	0.4464	0.4940	0.7492	0.9326	0.9806	0.9915	(94)
Useful gains	737.5521	837.9507	890.2171	920.4551	851.1636	648.4618	436.6292	457.3667	655.3834	737.3379	717.8732	706.6001	(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	1858.8798	1799.9081	1624.2677	1354.6243	1038.3365	692.1455	443.5617	468.3173	747.8434	1142.3965	1523.0543	1839.5571	(97)
Space heating kWh	834.2678	646.4354	546.1336	312.6018	139.2566	0.0000	0.0000	0.0000	0.0000	301.3636	579.7304	842.9200	(98a)
Space heating requirement - total per year (kWh/year)												4202.7093	
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	834.2678	646.4354	546.1336	312.6018	139.2566	0.0000	0.0000	0.0000	0.0000	301.3636	579.7304	842.9200	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4202.7093	
Space heating per m2											(98c) / (4) =	33.2335	(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 %)	89.0000	(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	834.2678	646.4354	546.1336	312.6018	139.2566	0.0000	0.0000	0.0000	0.0000	301.3636	579.7304	842.9200	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	937.3796	726.3319	613.6333	351.2380	156.4681	0.0000	0.0000	0.0000	0.0000	338.6108	651.3825	947.1011	(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	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.6028	88.5623	88.4867	88.3300	88.0101	87.3000	87.3000	87.3000	87.3000	88.3135	88.5296	88.6099	(217)
Fuel for water heating, kWh/month	281.5895	248.2637	261.8827	225.8050	216.3425	192.8769	187.7619	197.3003	201.7582	226.7078	245.7159	277.8688	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	12.3475	11.1526	12.3475	11.9492	12.3475	11.9492	12.3475	12.3475	11.9492	12.3475	11.9492	12.3475	(231)
Lighting	36.7733	29.5009	26.5623	19.4607	15.0320	12.2813	13.7127	17.8243	23.1520	30.3766	34.3103	37.7954	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-47.3599	-71.0947	-108.6973	-126.2305	-136.5794	-127.2615	-125.3262	-117.9847	-103.6588	-83.3432	-53.1476	-40.1117	(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	-25.7915	-61.0977	-140.6494	-238.6697	-337.6672	-347.8098	-339.8020	-273.3824	-181.1778	-92.4874	-35.6816	-19.6774	(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												4722.1453	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2763.8732	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543)													
mechanical ventilation fans (SFP = 0.1543)												59.3821	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												145.3821	(231)
Electricity for lighting (calculated in Appendix L)												296.7817	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3234.6895	(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	4693.4929	(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	4722.1453	0.2100	991.6505	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2763.8732	0.2100	580.4134	(264)
Space and water heating			1572.0639	(265)
Pumps, fans and electric keep-hot	145.3821	0.1387	20.1663	(267)
Energy for lighting	296.7817	0.1443	42.8348	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1140.7956	0.1339	-152.7464	
PV Unit electricity exported	-2093.8939	0.1230	-257.5065	
Total			-410.2529	(269)
Total CO2, kg/year			1224.8121	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.6900	(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	4722.1453	1.1300	5336.0242	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2763.8732	1.1300	3123.1767	(278)
Space and water heating			8459.2009	(279)
Pumps, fans and electric keep-hot	145.3821	1.5128	219.9341	(281)
Energy for lighting	296.7817	1.5338	455.2138	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1140.7956	1.4948	-1705.2872	
PV Unit electricity exported	-2093.8939	0.4513	-944.9457	
Total			-2650.2329	(283)
Total Primary energy kWh/year			6484.1157	(286)
Dwelling Primary energy Rate (DPER)			51.2700	(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	63.2300 (1b)	x	2.3100 (2b)	=	146.0613	(1b) - (3b)
First floor	63.2300 (1c)	x	2.6800 (2c)	=	169.4564	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 126.4600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	315.5177	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1268 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3768 (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) =	0.3203 (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	0.4083	0.4003	0.3923	0.3523	0.3443	0.3042	0.3042	0.2962	0.3203	0.3443	0.3603	0.3763	(22b)

Effective ac	0.5834	0.5801	0.5770	0.5621	0.5593	0.5463	0.5463	0.5439	0.5513	0.5593	0.5649	0.5708 (25)

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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			4.0500	1.0000	4.0500			(26)
TER Opening Type (Uw = 1.20)			19.2500	1.1450	22.0420			(27)
GF			63.2300	0.1300	8.2199			(28a)
Main	167.8137	23.3000	144.5137	0.1800	26.0125			(29a)
PIJ	63.2300		63.2300	0.1100	6.9553			(30)
Total net area of external elements Aum(A, m2)			294.2737					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.2797			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 190.7504 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	18.4200	0.0500	0.9210
E3	Sill	18.4200	0.0500	0.9210
E4	Jamb	36.3000	0.0500	1.8150
E5	Ground floor (normal)	33.6300	0.1600	5.3808
E6	Intermediate floor within a dwelling	33.6300	0.0000	0.0000
E16	Corner (normal)	29.9400	0.0900	2.6946
E17	Corner (inverted - internal area greater than external area)	9.9800	-0.0900	-0.8982
E10	Eaves (insulation at ceiling level)	18.9300	0.0600	1.1358
E12	Gable (insulation at ceiling level)	14.7100	0.0600	0.8826

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8526 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 80.1323 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.7407	60.4036	60.0732	58.5214	58.2310	56.8794	56.8794	56.6291	57.4001	58.2310	58.8184	59.4325	(38)
Heat transfer coeff	140.8729	140.5358	140.2055	138.6536	138.3633	137.0117	137.0117	136.7614	137.5323	138.3633	138.9506	139.5647	(39)
Average = Sum(39)m / 12 =												138.6522	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1140	1.1113	1.1087	1.0964	1.0941	1.0834	1.0834	1.0815	1.0876	1.0941	1.0988	1.1036	(40)
HLP (average)												1.0964	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8852 (42)

Hot water usage for mixer showers

72.5949	71.5039	69.9142	66.8725	64.6278	62.1246	60.7017	62.2794	64.0089	66.6966	69.8036	72.3167	(42a)

Hot water usage for baths

31.3414	30.8759	30.2205	29.0119	28.1069	27.1035	26.5615	27.2123	27.9210	28.9948	30.2282	31.2354	(42b)

Hot water usage for other uses

44.1772	42.5707	40.9643	39.3578	37.7514	36.1450	36.1450	37.7514	39.3578	40.9643	42.5707	44.1772	(42c)

Average daily hot water use (litres/day) 136.1495 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.1135	144.9506	141.0989	135.2422	130.4862	125.3730	123.4081	127.2432	131.2878	136.6557	142.6026	147.7294	(44)
Energy conte	234.5755	206.4077	216.8638	185.1399	175.6594	154.1607	149.2514	157.5536	161.8909	185.4405	203.1636	231.3085	(45)
Energy content (annual)										Total = Sum(45)m =		2261.4156	
Distribution loss (46)m = 0.15 x (45)m	35.1863	30.9612	32.5296	27.7710	26.3489	23.1241	22.3877	23.6330	24.2836	27.8161	30.4745	34.6963	(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	285.5344	252.4351	267.8227	234.4549	226.6183	203.4758	200.2103	208.5125	211.2060	236.3994	252.4786	282.2674	(62)
WWHRS	-33.1874	-29.3512	-30.7348	-25.4497	-23.7182	-20.2958	-19.0241	-20.2302	-20.9988	-24.7553	-28.0448	-32.5728	(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	252.3471	223.0840	237.0879	209.0053	202.9002	183.1800	181.1862	188.2823	190.2072	211.6441	224.4339	249.6946	(64)
										Total per year (kWh/year) = Sum(64)m =		2553.0526	(64)
12Total per year (kWh/year)												2553	(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	90.7361	80.1374	84.8469	73.8878	71.1465	63.5872	62.3658	65.1263	66.1575	74.3987	79.8806	89.6498	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	155.9581	172.6679	155.9581	161.1567	155.9581	161.1567	155.9581	155.9581	161.1567	155.9581	161.1567	155.9581	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	293.4013	296.4459	288.7736	272.4403	251.8224	232.4445	219.4988	216.4542	224.1265	240.4598	261.0777	280.4557	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	(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)	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	(71)
Water heating gains (Table 5)	121.9571	119.2521	114.0416	102.6219	95.6270	88.3156	83.8250	87.5354	91.8854	99.9982	110.9453	120.4970	(72)
Total internal gains	640.5943	657.6437	628.0511	605.4967	572.6853	548.1945	525.5598	526.2255	543.4464	565.6940	602.4576	626.1886	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.7500	10.6334	0.6300	0.7000	0.7700	8.9367	(74)
East	9.4500	19.6403	0.6300	0.7000	0.7700	56.7219	(76)
South	5.6100	46.7521	0.6300	0.7000	0.7700	80.1559	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	154.4578	276.2215	406.8221	542.7297	636.1257	642.0543	614.7663	544.7264	454.4881	313.6483	187.5394	130.4653	(83)
Total gains	795.0522	933.8652	1034.8732	1148.2264	1208.8110	1190.2489	1140.3260	1070.9518	997.9345	879.3423	789.9970	756.6540	(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	47.5651	47.6792	47.7916	48.3265	48.4279	48.9056	48.9056	48.9951	48.7205	48.4279	48.2232	48.0110	
alpha	4.1710	4.1786	4.1861	4.2218	4.2285	4.2604	4.2604	4.2663	4.2480	4.2285	4.2149	4.2007	
util living area	0.9928	0.9853	0.9700	0.9261	0.8331	0.6707	0.5116	0.5608	0.7886	0.9475	0.9862	0.9941	(86)
MIT	19.3561	19.5874	19.9165	20.3514	20.7046	20.9168	20.9794	20.9697	20.8286	20.3601	19.7841	19.3214	(87)
Th 2	19.9894	19.9916	19.9937	20.0038	20.0056	20.0144	20.0144	20.0160	20.0110	20.0056	20.0018	19.9979	(88)
util rest of house	0.9910	0.9816	0.9621	0.9060	0.7878	0.5891	0.4048	0.4524	0.7187	0.9291	0.9821	0.9926	(89)
MIT 2	18.0701	18.3656	18.7829	19.3273	19.7387	19.9591	20.0059	20.0024	19.8811	19.3490	18.6249	18.0316	(90)
Living area fraction										fLA = Living area / (4) =		0.1827	(91)
MIT	18.3050	18.5888	18.9900	19.5144	19.9151	20.1341	20.1837	20.1791	20.0542	19.5337	18.8367	18.2672	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3050	18.5888	18.9900	19.5144	19.9151	20.1341	20.1837	20.1791	20.0542	19.5337	18.8367	18.2672	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9864	0.9743	0.9516	0.8939	0.7831	0.5997	0.4237	0.4712	0.7222	0.9178	0.9751	0.9887	(94)
Useful gains	784.2380	909.8434	984.7852	1026.3864	946.5834	713.7821	483.1993	504.6236	720.6650	807.0210	770.3546	748.1213	(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	1972.9274	1923.7644	1751.1607	1471.7229	1136.6693	758.2310	491.0097	516.8330	818.8885	1236.0945	1630.8154	1963.2837	(97)
Space heating kWh	884.3849	681.3549	570.1834	320.6423	141.4239	0.0000	0.0000	0.0000	0.0000	319.2306	619.5318	904.0808	(98a)
Space heating requirement - total per year (kWh/year)												4440.8325	
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	884.3849	681.3549	570.1834	320.6423	141.4239	0.0000	0.0000	0.0000	0.0000	319.2306	619.5318	904.0808	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4440.8325	
Space heating per m2											(98c) / (4) =	35.1165	(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	884.3849	681.3549	570.1834	320.6423	141.4239	0.0000	0.0000	0.0000	0.0000	319.2306	619.5318	904.0808	(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)	957.1265	737.3970	617.0816	347.0155	153.0562	0.0000	0.0000	0.0000	0.0000	345.4877	670.4890	978.4424	(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	252.3471	223.0840	237.0879	209.0053	202.9002	183.1800	181.1862	188.2823	190.2072	211.6441	224.4339	249.6946	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.8355	86.6120	86.1890	85.2952	83.6226	80.3000	80.3000	80.3000	80.3000	85.2597	86.4382	86.8862	(217)
Fuel for water heating, kWh/month	290.6037	257.5669	275.0789	245.0375	242.6380	228.1195	225.6367	234.4736	236.8707	248.2347	259.6466	287.3813	(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	32.4050	25.9965	23.4070	17.1490	13.2463	10.8224	12.0838	15.7069	20.4017	26.7682	30.2346	33.3057	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-56.3520	-78.0416	-110.1833	-121.5585	-129.0746	-119.6750	-118.1008	-112.4133	-102.1620	-88.0502	-61.4140	-48.8779	(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	-36.2292	-75.6734	-149.4637	-223.1734	-293.8927	-294.9451	-291.5593	-247.4780	-182.1571	-107.8792	-48.2494	-28.6977	(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	(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	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	4806.0958	(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	3031.2881	(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)	261.5271	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3125.3012	(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	5059.6099	(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	4806.0958	0.2100	1009.2801	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3031.2881	0.2100	636.5705	(264)
Space and water heating			1645.8506	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	261.5271	0.1443	37.7464	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1145.9031	0.1350	-154.6905	
PV Unit electricity exported	-1979.3980	0.1261	-249.5280	
Total			-404.2184	(269)
Total CO2, kg/year			1291.3079	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.2100	(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	4806.0958	1.1300	5430.8883	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3031.2881	1.1300	3425.3556	(278)
Space and water heating			8856.2439	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	261.5271	1.5338	401.1389	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1145.9031	1.4989	-1717.6391	
PV Unit electricity exported	-1979.3980	0.4627	-915.9531	
Total			-2633.5922	(283)
Total Primary energy kWh/year			6753.8914	(286)
Target Primary Energy Rate (TPER)			53.4100	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.2300	(1b)	x 2.3100	(2b)	= 146.0613	(1b) - (3b)
First floor	63.2300	(1c)	x 2.6800	(2c)	= 169.4564	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	126.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 315.5177	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1268	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3768	(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) =	0.3203	(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													
	0.4083	0.4003	0.3923	0.3523	0.3443	0.3042	0.3042	0.2962	0.3203	0.3443	0.3603	0.3763	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5834	0.5801	0.5770	0.5621	0.5593	0.5463	0.5463	0.5439	0.5513	0.5593	0.5649	0.5708	(25)

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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	
Door			4.0500	1.0000	4.0500			(26)
Window (Uw = 1.20)			19.2500	1.1450	22.0420			(27)
GF			63.2300	0.1100	6.9553	75.0000	4742.2500	(28a)
Main	167.8137	23.3000	144.5137	0.1800	26.0125	110.0000	15896.5070	(29a)
PIJ	63.2300		63.2300	0.1000	6.3230	9.0000	569.0700	(30)
Total net area of external elements Aum(A, m2)			294.2737					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.3828			(33)
Internal Wall 1			134.1400			9.0000	1207.2600	(32c)
Internal Floor 1			63.2300			18.0000	1138.1400	(32d)
Internal Ceiling 1			63.2300			9.0000	569.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 24122.2970	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	190.7504	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	18.4200	0.0500	0.9210
E3 Sill	18.4200	0.0200	0.3684
E4 Jamb	36.3000	0.0160	0.5808
E5 Ground floor (normal)	33.6300	0.1080	3.6320
E6 Intermediate floor within a dwelling	33.6300	0.0000	0.0000
E16 Corner (normal)	29.9400	0.0510	1.5269
E17 Corner (inverted - internal area greater than external area)	9.9800	-0.0700	-0.6986
E10 Eaves (insulation at ceiling level)	18.9300	0.1220	2.3095
E12 Gable (insulation at ceiling level)	14.7100	0.0770	1.1327

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.7727	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 75.1555	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.7407	60.4036	60.0732	58.5214	58.2310	56.8794	56.8794	56.6291	57.4001	58.2310	58.8184	59.4325	(38)
Heat transfer coeff													
	135.8961	135.5591	135.2287	133.6768	133.3865	132.0349	132.0349	131.7846	132.5555	133.3865	133.9739	134.5879	(39)
Average = Sum(39)m / 12 =												133.6754	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0746	1.0720	1.0693	1.0571	1.0548	1.0441	1.0441	1.0421	1.0482	1.0548	1.0594	1.0643	(40)
HLP (average)												1.0571	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8852	(42)

Hot water usage for mixer showers

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

	31.3414	30.8759	30.2205	29.0119	28.1069	27.1035	26.5615	27.2123	27.9210	28.9948	30.2282	31.2354	(42b)

Hot water usage for other uses

	44.1772	42.5707	40.9643	39.3578	37.7514	36.1450	36.1450	37.7514	39.3578	40.9643	42.5707	44.1772	(42c)

Average daily hot water use (litres/day)	69.2195 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	75.5186	73.4467	71.1848	68.3697	65.8583	63.2484	62.7064	64.9637	67.2789	69.9591	72.7990	75.4126	(44)
Energy conte	119.6030	104.5871	109.4083	93.5948	88.6580	77.7713	75.8380	80.4387	82.9616	94.9338	103.7155	118.0779	(45)
Energy content (annual)										Total = Sum(45)m =		1149.5879	

Distribution loss (46)m = 0.15 x (45)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	(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	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

	101.6625	88.8990	92.9971	79.5555	75.3593	66.1056	64.4623	68.3729	70.5174	80.6937	88.1581	100.3662	(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													
	101.6625	88.8990	92.9971	79.5555	75.3593	66.1056	64.4623	68.3729	70.5174	80.6937	88.1581	100.3662	(64)
										Total per year (kWh/year) = Sum(64)m =		977.1497	(64)
12Total per year (kWh/year)												977	(64)

Electric shower(s)

	58.1364	51.8000	56.5636	53.9780	54.9909	52.4559	54.2045	54.9909	53.9780	56.5636	55.5000	58.1364	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	661.2983 (64a)

Heat gains from water heating, kWh/month

	39.9497	35.1748	37.3902	33.3834	32.5875	29.6404	29.6667	30.8409	31.1238	34.3143	35.9145	39.6257 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	155.9581	172.6679	155.9581	161.1567	155.9581	161.1567	155.9581	155.9581	161.1567	155.9581	161.1567	155.9581	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	293.4013	296.4459	288.7736	272.4403	251.8224	232.4445	219.4988	216.4542	224.1265	240.4598	261.0777	280.4557	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	(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)													
	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	(71)
Water heating gains (Table 5)													
	53.6959	52.3434	50.2556	46.3658	43.8005	41.1672	39.8746	41.4529	43.2275	46.1214	49.8813	53.2603	(72)
Total internal gains													
	569.3331	587.7350	561.2651	546.2406	517.8587	501.0462	481.6093	480.1430	494.7885	508.8172	538.3936	555.9519	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.7500	10.6334	0.3000	0.0000	0.7700	6.7549	(74)
East	9.4500	19.6403	0.3000	0.0000	0.7700	42.8737	(76)
South	5.6100	46.7521	0.3000	0.0000	0.7700	60.5865	(78)
West	1.4400	19.6403	0.3000	0.0000	0.7700	6.5331	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	116.7482	208.7842	307.4997	410.2265	480.8206	485.3018	464.6759	411.7357	343.5284	237.0735	141.7532	98.6133	(83)
Total gains	686.0813	796.5192	868.7648	956.4671	998.6794	986.3480	946.2852	891.8787	838.3170	745.8907	680.1467	654.5651	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.3071	49.4297	49.5504	50.1256	50.2348	50.7490	50.7490	50.8454	50.5497	50.2348	50.0145	49.7863	
alpha	4.2871	4.2953	4.3034	4.3417	4.3490	4.3833	4.3833	4.3897	4.3700	4.3490	4.3343	4.3191	
util living area													
	0.9959	0.9916	0.9830	0.9556	0.8894	0.7464	0.5838	0.6340	0.8474	0.9677	0.9919	0.9966	(86)
MIT	19.3170	19.5214	19.8242	20.2505	20.6245	20.8838	20.9696	20.9565	20.7820	20.2908	19.7355	19.2891	(87)
Th 2	20.0216	20.0238	20.0260	20.0360	20.0379	20.0468	20.0468	20.0484	20.0434	20.0379	20.0341	20.0301	(88)
util rest of house													
	0.9948	0.9894	0.9783	0.9422	0.8540	0.6686	0.4706	0.5220	0.7877	0.9555	0.9894	0.9958	(89)
MIT 2	18.4789	18.6839	18.9857	19.4102	19.7616	19.9830	20.0364	20.0321	19.9072	19.4557	18.9056	18.4574	(90)
Living area fraction									fLA = Living area / (4) =			0.1827	(91)
MIT	18.6320	18.8369	19.1389	19.5637	19.9192	20.1475	20.2068	20.2009	20.0670	19.6083	19.0572	18.6093	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6320	18.8369	19.1389	19.5637	19.9192	20.1475	20.2068	20.2009	20.0670	19.6083	19.0572	18.6093	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9926	0.9857	0.9725	0.9340	0.8489	0.6777	0.4906	0.5412	0.7894	0.9483	0.9858	0.9939	(94)
Useful gains	680.9895	785.1227	844.8803	893.3186	847.7709	668.4056	464.2665	482.6412	661.7495	707.3159	670.4962	650.5733	(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													
	1947.6569	1889.2666	1709.1391	1425.4919	1096.3322	732.4690	476.2264	500.9047	790.9622	1201.5814	1601.9523	1939.3194	(97)
Space heating kWh													
	942.4005	741.9847	643.0086	383.1648	184.9296	0.0000	0.0000	0.0000	0.0000	367.7335	670.6484	958.8271	(98a)
Space heating requirement - total per year (kWh/year)												4892.6973	
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													
	942.4005	741.9847	643.0086	383.1648	184.9296	0.0000	0.0000	0.0000	0.0000	367.7335	670.6484	958.8271	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4892.6973	
Space heating per m2											(98c) / (4) =	38.6897	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1241.1281	977.0583	1001.5630	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7544	0.8381	0.8046	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	936.3590	818.8670	805.8238	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1081.8809	1038.2572	977.8341	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	104.7757	163.2263	127.9756	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	26.1939	40.8066	31.9939	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												98.9944	(107)
Energy for space heating												38.6897	(99)
Energy for space cooling												0.7828	(108)

Total 39.4725 (109)
Fabric Energy Efficiency (DFEE) 39.5 (109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.2300 (1b)	x	2.3100 (2b)	=	146.0613	(1b) - (3b)
First floor	63.2300 (1c)	x	2.6800 (2c)	=	169.4564	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	126.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	315.5177	(5)

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2. Ventilation rate

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	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1268 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3768 (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) =		0.3203 (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	0.4083	0.4003	0.3923	0.3523	0.3443	0.3042	0.3042	0.2962	0.3203	0.3443	0.3603	0.3763	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5834	0.5801	0.5770	0.5621	0.5593	0.5463	0.5463	0.5439	0.5513	0.5593	0.5649	0.5708	(25)

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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			4.0500	1.0000	4.0500			(26)
TER Opening Type (Uw = 1.20)			19.2500	1.1450	22.0420			(27)
GF			63.2300	0.1300	8.2199			(28a)
Main	167.8137	23.3000	144.5137	0.1800	26.0125			(29a)
PIJ	63.2300		63.2300	0.1100	6.9553			(30)
Total net area of external elements Aum(A, m2)			294.2737					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.2797			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 190.7504 (35)

List of Thermal Bridges

		Length	Psi-value	Total
K1	Element			
E2	Other lintels (including other steel lintels)	18.4200	0.0500	0.9210
E3	Sill	18.4200	0.0500	0.9210
E4	Jamb	36.3000	0.0500	1.8150
E5	Ground floor (normal)	33.6300	0.1600	5.3808
E6	Intermediate floor within a dwelling	33.6300	0.0000	0.0000
E16	Corner (normal)	29.9400	0.0900	2.6946
E17	Corner (inverted - internal area greater than external area)	9.9800	-0.0900	-0.8982
E10	Eaves (insulation at ceiling level)	18.9300	0.0600	1.1358
E12	Gable (insulation at ceiling level)	14.7100	0.0600	0.8826

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8526 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 80.1323 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.7407	60.4036	60.0732	58.5214	58.2310	56.8794	56.8794	56.6291	57.4001	58.2310	58.8184	59.4325	(38)
Heat transfer coeff	140.8729	140.5358	140.2055	138.6536	138.3633	137.0117	137.0117	136.7614	137.5323	138.3633	138.9506	139.5647	(39)
Average = Sum(39)m / 12 =												138.6522	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1140	1.1113	1.1087	1.0964	1.0941	1.0834	1.0834	1.0815	1.0876	1.0941	1.0988	1.1036	(40)
HLP (average)												1.0964	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8852 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

31.3414	30.8759	30.2205	29.0119	28.1069	27.1035	26.5615	27.2123	27.9210	28.9948	30.2282	31.2354	(42b)

Hot water usage for other uses

44.1772	42.5707	40.9643	39.3578	37.7514	36.1450	36.1450	37.7514	39.3578	40.9643	42.5707	44.1772	(42c)

Average daily hot water use (litres/day) 69.2195 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	75.5186	73.4467	71.1848	68.3697	65.8583	63.2484	62.7064	64.9637	67.2789	69.9591	72.7990	75.4126	(44)
Energy conte	119.6030	104.5871	109.4083	93.5948	88.6580	77.7713	75.8380	80.4387	82.9616	94.9338	103.7155	118.0779	(45)
Energy content (annual)										Total = Sum(45)m =		1149.5879	
Distribution loss (46)m = 0.15 x (45)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	(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	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													
	101.6625	88.8990	92.9971	79.5555	75.3593	66.1056	64.4623	68.3729	70.5174	80.6937	88.1581	100.3662	(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													
	101.6625	88.8990	92.9971	79.5555	75.3593	66.1056	64.4623	68.3729	70.5174	80.6937	88.1581	100.3662	(64)
										Total per year (kWh/year) = Sum(64)m =		977.1497	(64)
12Total per year (kWh/year)												977	(64)
Electric shower(s)													
	58.1364	51.8000	56.5636	53.9780	54.9909	52.4559	54.2045	54.9909	53.9780	56.5636	55.5000	58.1364	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												661.2983	(64a)
Heat gains from water heating, kWh/month													
	39.9497	35.1748	37.3902	33.3834	32.5875	29.6404	29.6667	30.8409	31.1238	34.3143	35.9145	39.6257	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	144.2592	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	155.9581	172.6679	155.9581	161.1567	155.9581	161.1567	155.9581	155.9581	161.1567	155.9581	161.1567	155.9581	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	293.4013	296.4459	288.7736	272.4403	251.8224	232.4445	219.4988	216.4542	224.1265	240.4598	261.0777	280.4557	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	37.4259	(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)													
	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	(71)
Water heating gains (Table 5)													
	53.6959	52.3434	50.2556	46.3658	43.8005	41.1672	39.8746	41.4529	43.2275	46.1214	49.8813	53.2603	(72)
Total internal gains													
	569.3331	587.7350	561.2651	546.2406	517.8587	501.0462	481.6093	480.1430	494.7885	508.8172	538.3936	555.9519	(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	2.7500	10.6334	0.6300	0.7000	0.7700	8.9367	(74)
East	9.4500	19.6403	0.6300	0.7000	0.7700	56.7219	(76)
South	5.6100	46.7521	0.6300	0.7000	0.7700	80.1559	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	154.4578	276.2215	406.8221	542.7297	636.1257	642.0543	614.7663	544.7264	454.4881	313.6483	187.5394	130.4653	(83)
Total gains	723.7909	863.9565	968.0872	1088.9703	1153.9844	1143.1005	1096.3756	1024.8694	949.2766	822.4655	725.9330	686.4172	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.5651	47.6792	47.7916	48.3265	48.4279	48.9056	48.9056	48.9951	48.7205	48.4279	48.2232	48.0110	
alpha	4.1710	4.1786	4.1861	4.2218	4.2285	4.2604	4.2604	4.2663	4.2480	4.2285	4.2149	4.2007	
util living area													
	0.9949	0.9889	0.9760	0.9368	0.8500	0.6903	0.5296	0.5818	0.8093	0.9575	0.9898	0.9959	(86)
MIT	19.2833	19.5181	19.8544	20.3057	20.6769	20.9071	20.9765	20.9653	20.8088	20.3118	19.7202	19.2491	(87)
Th 2	19.9894	19.9916	19.9937	20.0038	20.0056	20.0144	20.0144	20.0160	20.0110	20.0056	20.0018	19.9979	(88)
util rest of house													
	0.9936	0.9860	0.9695	0.9189	0.8071	0.6087	0.4201	0.4711	0.7421	0.9419	0.9867	0.9949	(89)
MIT 2	18.4214	18.6562	18.9900	19.4347	19.7755	19.9657	20.0068	20.0036	19.8962	19.4492	18.8660	18.3937	(90)
Living area fraction										fLA = Living area / (4) =		0.1827	(91)
MIT	18.5789	18.8137	19.1479	19.5938	19.9402	20.1376	20.1839	20.1793	20.0629	19.6068	19.0220	18.5499	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5789	18.8137	19.1479	19.5938	19.9402	20.1376	20.1839	20.1793	20.0629	19.6068	19.0220	18.5499	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9909	0.9813	0.9623	0.9099	0.8038	0.6197	0.4397	0.4905	0.7461	0.9338	0.9824	0.9927	(94)
Useful gains	717.2359	847.8386	931.6217	990.8108	927.6045	708.3887	482.0544	502.6642	708.2244	768.0156	713.1645	681.3765	(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	2011.5057	1955.3710	1773.3059	1482.7373	1140.1350	758.7203	491.0355	516.8608	820.0905	1246.2074	1656.5683	2002.7433	(97)
Space heating kWh	962.9367	744.2618	626.2130	354.1870	158.1227	0.0000	0.0000	0.0000	0.0000	355.7747	679.2508	983.0969	(98a)
Space heating requirement - total per year (kWh/year)												4863.8434	
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	962.9367	744.2618	626.2130	354.1870	158.1227	0.0000	0.0000	0.0000	0.0000	355.7747	679.2508	983.0969	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4863.8434	
Space heating per m2											(98c) / (4) =	38.4615	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1287.9099	1013.8865	1039.3866	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8026	0.8750	0.8434	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1033.6676	887.1004	876.6309	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1265.0981	1213.6874	1133.2777	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	166.6299	242.9807	190.9452	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	41.6575	60.7452	47.7363	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												150.1390	(107)
Energy for space heating												38.4615	(99)
Energy for space cooling												1.1872	(108)
Total												39.6488	(109)
Fabric Energy Efficiency (TFEE)												39.6	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.2300	(1b)	x 2.3100	(2b)	= 146.0613	(1b) - (3b)
First floor	63.2300	(1c)	x 2.6800	(2c)	= 169.4564	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	126.4600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	315.5177	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour	
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)
Mechanical extract ventilation - decentralised													
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)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

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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	
Door			4.0500	1.0000	4.0500			(26)
Window (Uw = 1.20)			19.2500	1.1450	22.0420			(27)
GF			63.2300	0.1100	6.9553	75.0000	4742.2500	(28a)
Main	167.8137	23.3000	144.5137	0.1800	26.0125	110.0000	15896.5070	(29a)
PIJ	63.2300		63.2300	0.1000	6.3230	9.0000	569.0700	(30)
Total net area of external elements Aum(A, m2)			294.2737					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.3828			(33)
Internal Wall 1			134.1400			9.0000	1207.2600	(32c)
Internal Floor 1			63.2300			18.0000	1138.1400	(32d)
Internal Ceiling 1			63.2300			9.0000	569.0700	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24122.2970 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 190.7504 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	18.4200	0.0500	0.9210
E3 Sill	18.4200	0.0200	0.3684
E4 Jamb	36.3000	0.0160	0.5808
E5 Ground floor (normal)	33.6300	0.1080	3.6320
E6 Intermediate floor within a dwelling	33.6300	0.0000	0.0000
E16 Corner (normal)	29.9400	0.0510	1.5269
E17 Corner (inverted - internal area greater than external area)	9.9800	-0.0700	-0.6986
E10 Eaves (insulation at ceiling level)	18.9300	0.1220	2.3095
E12 Gable (insulation at ceiling level)	14.7100	0.0770	1.1327

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.7727 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 75.1555 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2405	53.6873	53.1342	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	(38)
Heat transfer coeff	129.3959	128.8428	128.2896	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	(39)

Average = Sum(39)m / 12 = 127.6226

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0232	1.0188	1.0145	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	(40)
HLP (average)												1.0092	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8852 (42)
Hot water usage for mixer showers

72.5949	71.5039	69.9142	66.8725	64.6278	62.1246	60.7017	62.2794	64.0089	66.6966	69.8036	72.3167	(42a)

Hot water usage for baths

31.3414	30.8759	30.2205	29.0119	28.1069	27.1035	26.5615	27.2123	27.9210	28.9948	30.2282	31.2354	(42b)

Hot water usage for other uses

44.1772	42.5707	40.9643	39.3578	37.7514	36.1450	36.1450	37.7514	39.3578	40.9643	42.5707	44.1772	(42c)

Average daily hot water use (litres/day) 136.1495 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.1135	144.9506	141.0989	135.2422	130.4862	125.3730	123.4081	127.2432	131.2878	136.6557	142.6026	147.7294	(44)
Energy conte	234.5755	206.4077	216.8638	185.1399	175.6594	154.1607	149.2514	157.5536	161.8909	185.4405	203.1636	231.3085	(45)
Energy content (annual)										Total = Sum(45)m =		2261.4156	
Distribution loss (46)m = 0.15 x (45)m	35.1863	30.9612	32.5296	27.7710	26.3489	23.1241	22.3877	23.6330	24.2836	27.8161	30.4745	34.6963	(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	14.9206	13.4603	14.8675	14.3137	14.7439	14.2208	14.6647	14.6896	14.2440	14.7732	14.3678	14.9108	(61)
Total heat required for water heating calculated for each month	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(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	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)
									Total per year (kWh/year) = Sum(64)m =			2435.5925	(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	81.7265	71.9956	75.8241	65.1374	62.0927	54.8136	53.2923	56.0590	57.3897	65.3523	71.1438	80.6378	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	42.0125	37.3152	30.3467	22.9744	17.1736	14.4987	15.6664	20.3637	27.3322	34.7045	40.5053	43.1802	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	437.9124	442.4566	431.0054	406.6273	375.8543	346.9320	327.6102	323.0660	334.5172	358.8953	389.6683	418.5905	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	(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)	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	(71)
Water heating gains (Table 5)	109.8475	107.1364	101.9141	90.4687	83.4580	76.1300	71.6294	75.3481	79.7080	87.8391	98.8109	108.3841	(72)
Total internal gains	705.6724	702.8081	679.1662	635.9704	592.3859	550.4608	527.8059	531.6778	554.4573	597.3388	644.8844	686.0548	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.7500	10.6334	0.3000	0.0000	0.7700	6.7549	(74)
East	9.4500	19.6403	0.3000	0.0000	0.7700	42.8737	(76)
South	5.6100	46.7521	0.3000	0.0000	0.7700	60.5865	(78)
West	1.4400	19.6403	0.3000	0.0000	0.7700	6.5331	(80)

Solar gains	116.7482	208.7842	307.4997	410.2265	480.8206	485.3018	464.6759	411.7357	343.5284	237.0735	141.7532	98.6133	(83)
Total gains	822.4206	911.5923	986.6659	1046.1969	1073.2065	1035.7626	992.4819	943.4135	897.9857	834.4124	786.6375	784.6681	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.7840	52.0063	52.2306	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	
alpha	4.4523	4.4671	4.4820	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	
util living area	0.9916	0.9856	0.9717	0.9363	0.8561	0.7088	0.5446	0.5909	0.8091	0.9499	0.9855	0.9931	(86)
MIT	19.5555	19.7363	20.0303	20.3967	20.7150	20.9137	20.9793	20.9701	20.8370	20.4282	19.9295	19.5362	(87)
Th 2	20.0640	20.0677	20.0713	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	(88)
util rest of house	0.9895	0.9820	0.9644	0.9189	0.8157	0.6313	0.4393	0.4852	0.7448	0.9326	0.9812	0.9914	(89)
MIT 2	18.7477	18.9295	19.2220	19.5817	19.8731	20.0320	20.0714	20.0674	19.9795	19.6175	19.1307	18.7395	(90)
Living area fraction									fLA = Living area / (4) =			0.1827	(91)
MIT	18.8953	19.0769	19.3696	19.7306	20.0269	20.1931	20.2372	20.2323	20.1361	19.7656	19.2766	18.8850	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7453	18.9269	19.2196	19.5806	19.8769	20.0431	20.0872	20.0823	19.9861	19.6156	19.1266	18.7350	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9761	0.9557	0.9073	0.8056	0.6281	0.4404	0.4857	0.7374	0.9215	0.9752	0.9879	(94)
Useful gains	810.3761	889.8331	942.9843	949.2395	864.5300	650.5785	437.0626	458.2051	662.1637	768.9414	767.1332	775.1349	(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	1869.1611	1807.2623	1631.7959	1358.7401	1040.2320	692.4438	443.6279	468.4429	748.8073	1146.9218	1529.9745	1849.0880	(97)
Space heating kWh	787.7360	616.5124	512.4759	294.8405	130.7223	0.0000	0.0000	0.0000	0.0000	281.2174	549.2457	799.0211	(98a)
Space heating requirement - total per year (kWh/year)												3971.7713	
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	787.7360	616.5124	512.4759	294.8405	130.7223	0.0000	0.0000	0.0000	0.0000	281.2174	549.2457	799.0211	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3971.7713	
Space heating per m2											(98c) / (4) =	31.4073	(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 %)	89.0000	(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	787.7360	616.5124	512.4759	294.8405	130.7223	0.0000	0.0000	0.0000	0.0000	281.2174	549.2457	799.0211	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	885.0967	692.7106	575.8156	331.2814	146.8790	0.0000	0.0000	0.0000	0.0000	315.9746	617.1300	897.7765	(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	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.5851	88.5467	88.4636	88.3061	87.9841	87.3000	87.3000	87.3000	87.3000	88.2850	88.5110	88.5936	(217)
Fuel for water heating, kWh/month	281.6459	248.3074	261.9510	225.8661	216.4064	192.8769	187.7619	197.3003	201.7582	226.7810	245.7675	277.9200	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	12.3475	11.1526	12.3475	11.9492	12.3475	11.9492	12.3475	12.3475	11.9492	12.3475	11.9492	12.3475	(231)
Lighting	36.7733	29.5009	26.5623	19.4607	15.0320	12.2813	13.7127	17.8243	23.1520	30.3766	34.3103	37.7954	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-47.3599	-71.0947	-108.6973	-126.2305	-136.5794	-127.2615	-125.3262	-117.9847	-103.6588	-83.3432	-53.1476	-40.1117	(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	-25.7915	-61.0977	-140.6494	-238.6697	-337.6672	-347.8098	-339.8020	-273.3824	-181.1778	-92.4874	-35.6816	-19.6774	(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	4462.6644 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	87.3000
Water heating fuel used	2764.3425 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(MEVDecentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543)	
mechanical ventilation fans (SFP = 0.1543)	59.3821 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	145.3821 (231)
Electricity for lighting (calculated in Appendix L)	296.7817 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-3234.6895 (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	4434.4814 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4462.6644	3.6400	162.4410	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2764.3425	3.6400	100.6221	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	145.3821	16.4900	23.9735	(249)
Energy for lighting	296.7817	16.4900	48.9393	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1140.7956	16.4900	-188.1172	
PV Unit electricity exported	-2093.8939	5.5900	-117.0487	
Total			-305.1659	(252)
Total energy cost			122.8100	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.2579 (257)
SAP value		95.8202
SAP rating (Section 12)		96 (258)
SAP band		A

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	4462.6644	0.2100	937.1595	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2764.3425	0.2100	580.5119	(264)
Space and water heating			1517.6715	(265)
Pumps, fans and electric keep-hot	145.3821	0.1387	20.1663	(267)
Energy for lighting	296.7817	0.1443	42.8348	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1140.7956	0.1339	-152.7464	
PV Unit electricity exported	-2093.8939	0.1230	-257.5065	
Total			-410.2529	(269)
Total CO2, kg/year			1170.4196	(272)
CO2 emissions per m2			9.2600	(273)
EI value			90.8529	
EI rating			91	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.2300 (1b)	x	2.3100 (2b)	=	146.0613	(1b) - (3b)
First floor	63.2300 (1c)	x	2.6800 (2c)	=	169.4564	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 126.4600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	315.5177	(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	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
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		5.0000	(17)
Infiltration rate		0.2500	(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) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate													
	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			4.0500	1.0000	4.0500			(26)
Window (Uw = 1.20)			19.2500	1.1450	22.0420			(27)
GF			63.2300	0.1100	6.9553	75.0000	4742.2500	(28a)
Main	167.8137	23.3000	144.5137	0.1800	26.0125	110.0000	15896.5070	(29a)
PIJ	63.2300		63.2300	0.1000	6.3230	9.0000	569.0700	(30)
Total net area of external elements Aum(A, m2)			294.2737					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.3828			(33)
Internal Wall 1			134.1400			9.0000	1207.2600	(32c)
Internal Floor 1			63.2300			18.0000	1138.1400	(32d)
Internal Ceiling 1			63.2300			9.0000	569.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 24122.2970	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	190.7504	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	18.4200	0.0500	0.9210
E3 Sill	18.4200	0.0200	0.3684
E4 Jamb	36.3000	0.0160	0.5808
E5 Ground floor (normal)	33.6300	0.1080	3.6320
E6 Intermediate floor within a dwelling	33.6300	0.0000	0.0000
E16 Corner (normal)	29.9400	0.0510	1.5269
E17 Corner (inverted - internal area greater than external area)	9.9800	-0.0700	-0.6986
E10 Eaves (insulation at ceiling level)	18.9300	0.1220	2.3095
E12 Gable (insulation at ceiling level)	14.7100	0.0770	1.1327

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.7727	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 75.1555	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	(38)
Heat transfer coeff													
	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	(39)
Average = Sum(39)m / 12 =												127.2159	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	(40)
HLP (average)												1.0060	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8852	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers													
	72.5949	71.5039	69.9142	66.8725	64.6278	62.1246	60.7017	62.2794	64.0089	66.6966	69.8036	72.3167	(42a)
Hot water usage for baths													
	31.3414	30.8759	30.2205	29.0119	28.1069	27.1035	26.5615	27.2123	27.9210	28.9948	30.2282	31.2354	(42b)
Hot water usage for other uses													
	44.1772	42.5707	40.9643	39.3578	37.7514	36.1450	36.1450	37.7514	39.3578	40.9643	42.5707	44.1772	(42c)
Average daily hot water use (litres/day)												136.1495	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	148.1135	144.9506	141.0989	135.2422	130.4862	125.3730	123.4081	127.2432	131.2878	136.6557	142.6026	147.7294	(44)
Energy conte	234.5755	206.4077	216.8638	185.1399	175.6594	154.1607	149.2514	157.5536	161.8909	185.4405	203.1636	231.3085	(45)
Energy content (annual)											Total = Sum(45)m =	2261.4156	
Distribution loss (46)m = 0.15 x (45)m													
	35.1863	30.9612	32.5296	27.7710	26.3489	23.1241	22.3877	23.6330	24.2836	27.8161	30.4745	34.6963	(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	14.9206	13.4603	14.8675	14.3137	14.7439	14.2208	14.6647	14.6896	14.2440	14.7732	14.3678	14.9108	(61)
Total heat required for water heating calculated for each month													
	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(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													
	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)
										Total per year (kWh/year) = Sum(64)m =		2435.5925	(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													
	81.7265	71.9956	75.8241	65.1374	62.0927	54.8136	53.2923	56.0590	57.3897	65.3523	71.1438	80.6378	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	42.0125	37.3152	30.3467	22.9744	17.1736	14.4987	15.6664	20.3637	27.3322	34.7045	40.5053	43.1802	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	437.9124	442.4566	431.0054	406.6273	375.8543	346.9320	327.6102	323.0660	334.5172	358.8953	389.6683	418.5905	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	(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)													
	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	(71)
Water heating gains (Table 5)													
	109.8475	107.1364	101.9141	90.4687	83.4580	76.1300	71.6294	75.3481	79.7080	87.8391	98.8109	108.3841	(72)
Total internal gains													
	705.6724	702.8081	679.1662	635.9704	592.3859	550.4608	527.8059	531.6778	554.4573	597.3388	644.8844	686.0548	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.7500	9.8154	0.3000	0.0000	0.7700	6.2353	(74)
East	9.4500	18.1295	0.3000	0.0000	0.7700	39.5757	(76)
South	5.6100	43.1558	0.3000	0.0000	0.7700	55.9260	(78)
West	1.4400	18.1295	0.3000	0.0000	0.7700	6.0306	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	107.7676	197.1851	285.0778	382.8781	460.7864	461.0367	445.0071	388.1330	325.6052	226.2975	133.1621	98.6133	(83)
Total gains	813.4399	899.9931	964.2441	1018.8485	1053.1724	1011.4975	972.8130	919.8109	880.0625	823.6363	778.0464	784.6681	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	
alpha	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	
util living area													
	0.9910	0.9851	0.9709	0.9349	0.8469	0.6718	0.5093	0.5472	0.7988	0.9488	0.9849	0.9926	(86)
MIT	19.6338	19.7891	20.0757	20.4223	20.7410	20.9371	20.9855	20.9803	20.8527	20.4437	19.9610	19.5769	(87)
Th 2	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	(88)
util rest of house													
	0.9888	0.9814	0.9632	0.9165	0.8031	0.5855	0.3986	0.4335	0.7298	0.9309	0.9803	0.9907	(89)
MIT 2	18.8365	18.9902	19.2724	19.6068	19.8960	20.0477	20.0742	20.0723	19.9920	19.6325	19.1620	18.7801	(90)
Living area fraction										fLA = Living area / (4) =		0.1827	(91)
MIT	18.9822	19.1361	19.4191	19.7558	20.0504	20.2102	20.2406	20.2382	20.1492	19.7807	19.3079	18.9256	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8322	18.9861	19.2691	19.6058	19.9004	20.0602	20.0906	20.0882	19.9992	19.6307	19.1579	18.7756	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9845	0.9754	0.9544	0.9048	0.7934	0.5836	0.4001	0.4347	0.7230	0.9197	0.9742	0.9870	(94)
Useful gains	800.8384	877.8319	920.3070	921.8957	835.5771	590.3527	389.2190	399.8834	636.3269	757.5023	757.9341	774.4571	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W													
	1797.8358	1753.8099	1573.5486	1311.0600	992.3307	618.2947	393.1791	405.5848	712.3134	1123.4007	1495.7978	1816.0880	(97)
Space heating kWh													
	741.7661	588.6572	486.0118	280.1983	116.6247	0.0000	0.0000	0.0000	0.0000	272.2284	531.2619	774.9734	(98a)
Space heating requirement - total per year (kWh/year)												3791.7217	
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													
	741.7661	588.6572	486.0118	280.1983	116.6247	0.0000	0.0000	0.0000	0.0000	272.2284	531.2619	774.9734	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3791.7217	
Space heating per m2											(98c) / (4) =	29.9836	(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 %)												89.0000	(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													
	741.7661	588.6572	486.0118	280.1983	116.6247	0.0000	0.0000	0.0000	0.0000	272.2284	531.2619	774.9734	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	833.4450	661.4126	546.0806	314.8296	131.0389	0.0000	0.0000	0.0000	0.0000	305.8746	596.9234	870.7567	(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													
	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.5659	88.5312	88.4439	88.2851	87.9380	87.3000	87.3000	87.3000	87.3000	88.2715	88.4993	88.5841	(217)
Fuel for water heating, kWh/month													
	281.7068	248.3509	262.0093	225.9199	216.5199	192.8769	187.7619	197.3003	201.7582	226.8157	245.7999	277.9498	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	12.3475	11.1526	12.3475	11.9492	12.3475	11.9492	12.3475	12.3475	11.9492	12.3475	11.9492	12.3475	(231)
Lighting	36.7733	29.5009	26.5623	19.4607	15.0320	12.2813	13.7127	17.8243	23.1520	30.3766	34.3103	37.7954	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-44.4852	-68.3546	-103.9972	-122.2281	-134.4412	-125.0893	-123.5116	-115.2557	-100.9699	-80.9624	-50.7394	-40.1117	(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	-23.0391	-56.4938	-127.1679	-218.3455	-320.0452	-326.2284	-321.9287	-253.6763	-169.0056	-86.8759	-32.7062	-19.6774	(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												4260.3615	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												87.3000	
Water heating fuel used												2764.7694	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543)													
mechanical ventilation fans (SFP = 0.1543)												59.3821	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												145.3821	(231)
Electricity for lighting (calculated in Appendix L)												296.7817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3065.3364	(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												4401.9583	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4260.3615	4.8000	204.4974	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2764.7694	4.8000	132.7089	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	145.3821	21.5100	31.2717	(249)
Energy for lighting	296.7817	21.5100	63.8378	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1110.1463	21.5100	-238.7925	
PV Unit electricity exported	-1955.1901	5.5900	-109.2951	
Total			-348.0876	(252)
Total energy cost			182.2281	(255)

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	4260.3615	0.2100	894.6759	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2764.7694	0.2100	580.6016	(264)
Space and water heating			1475.2775	(265)
Pumps, fans and electric keep-hot	145.3821	0.1387	20.1663	(267)
Energy for lighting	296.7817	0.1443	42.8348	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1110.1463	0.1338	-148.4825	
PV Unit electricity exported	-1955.1901	0.1227	-239.9694	

Total		-388.4519 (269)
Total CO2, kg/year		1149.8267 (272)

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	4260.3615	1.1300	4814.2085	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2764.7694	1.1300	3124.1894	(278)
Space and water heating			7938.3978	(279)
Pumps, fans and electric keep-hot	145.3821	1.5128	219.9341	(281)
Energy for lighting	296.7817	1.5338	455.2138	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1110.1463	1.4943	-1658.8701	
PV Unit electricity exported	-1955.1901	0.4504	-880.5495	
Total			-2539.4196	(283)
Total Primary energy kWh/year			6074.1260	(286)

SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating: A 96
Current environmental impact rating: B 91

N Solar water heating	SAP increase too small	
U Solar photovoltaic panels	Already installed	
V2 Wind turbine	Not applicable	

Recommended measures:	SAP change	Cost change	CO2 change
(none)			
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.5	-£ 16	-125 kg (10.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: A 96
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, East Pennines):

	Current	Potential	Saving
Electricity	£95	£95	£0
Mains gas	£435	£435	£0
Space heating	£334	£334	£0
Water heating	£133	£133	£0
Lighting	£64	£64	£0
Generated (PV)	-£348	-£348	£0
Total cost of fuels	£182	£182	£0
Total cost of uses	£183	£183	£0
Delivered energy	35 kWh/m²	35 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	9 kg/m²	9 kg/m²	0 kg/m²
Primary energy	48 kWh/m²	48 kWh/m²	0 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.2300	(1b)	x 2.3100	(2b)	= 146.0613	(1b) - (3b)
First floor	63.2300	(1c)	x 2.6800	(2c)	= 169.4564	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	126.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		= 315.5177	(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	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
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		5.0000 (17)
Infiltration rate		0.2500 (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) =	0.2125 (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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			4.0500	1.0000	4.0500			(26)
Window (Uw = 1.20)			19.2500	1.1450	22.0420			(27)
GF			63.2300	0.1100	6.9553	75.0000	4742.2500	(28a)
Main	167.8137	23.3000	144.5137	0.1800	26.0125	110.0000	15896.5070	(29a)
PIJ	63.2300		63.2300	0.1000	6.3230	9.0000	569.0700	(30)
Total net area of external elements Aum(A, m2)			294.2737					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.3828			(33)
Internal Wall 1			134.1400			9.0000	1207.2600	(32c)
Internal Floor 1			63.2300			18.0000	1138.1400	(32d)
Internal Ceiling 1			63.2300			9.0000	569.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	24122.2970 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		190.7504 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	18.4200	0.0500	0.9210
E3 Sill	18.4200	0.0200	0.3684
E4 Jamb	36.3000	0.0160	0.5808
E5 Ground floor (normal)	33.6300	0.1080	3.6320
E6 Intermediate floor within a dwelling	33.6300	0.0000	0.0000
E16 Corner (normal)	29.9400	0.0510	1.5269
E17 Corner (inverted - internal area greater than external area)	9.9800	-0.0700	-0.6986
E10 Eaves (insulation at ceiling level)	18.9300	0.1220	2.3095
E12 Gable (insulation at ceiling level)	14.7100	0.0770	1.1327

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.7727 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	75.1555 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2405	53.6873	53.1342	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	(38)
Heat transfer coeff	129.3959	128.8428	128.2896	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	(39)
Average = Sum(39)m / 12 =												127.6226	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0232	1.0188	1.0145	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	(40)
HLP (average)												1.0092	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8852 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.5949	71.5039	69.9142	66.8725	64.6278	62.1246	60.7017	62.2794	64.0089	66.6966	69.8036	72.3167	(42a)

Hot water usage for baths

31.3414	30.8759	30.2205	29.0119	28.1069	27.1035	26.5615	27.2123	27.9210	28.9948	30.2282	31.2354	(42b)

Hot water usage for other uses

44.1772	42.5707	40.9643	39.3578	37.7514	36.1450	36.1450	37.7514	39.3578	40.9643	42.5707	44.1772	(42c)

Average daily hot water use (litres/day)		136.1495 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.1135	144.9506	141.0989	135.2422	130.4862	125.3730	123.4081	127.2432	131.2878	136.6557	142.6026	147.7294	(44)
Energy conte	234.5755	206.4077	216.8638	185.1399	175.6594	154.1607	149.2514	157.5536	161.8909	185.4405	203.1636	231.3085	(45)
Energy content (annual)										Total = Sum(45)m =		2261.4156	
Distribution loss (46)m = 0.15 x (45)m	35.1863	30.9612	32.5296	27.7710	26.3489	23.1241	22.3877	23.6330	24.2836	27.8161	30.4745	34.6963	(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	14.9206	13.4603	14.8675	14.3137	14.7439	14.2208	14.6647	14.6896	14.2440	14.7732	14.3678	14.9108	(61)
Total heat required for water heating calculated for each month	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(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	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)
									Total per year (kWh/year) = Sum(64)m =			2435.5925	(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	81.7265	71.9956	75.8241	65.1374	62.0927	54.8136	53.2923	56.0590	57.3897	65.3523	71.1438	80.6378	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	42.0125	37.3152	30.3467	22.9744	17.1736	14.4987	15.6664	20.3637	27.3322	34.7045	40.5053	43.1802	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	437.9124	442.4566	431.0054	406.6273	375.8543	346.9320	327.6102	323.0660	334.5172	358.8953	389.6683	418.5905	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	(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)	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	(71)
Water heating gains (Table 5)	109.8475	107.1364	101.9141	90.4687	83.4580	76.1300	71.6294	75.3481	79.7080	87.8391	98.8109	108.3841	(72)
Total internal gains	705.6724	702.8081	679.1662	635.9704	592.3859	550.4608	527.8059	531.6778	554.4573	597.3388	644.8844	686.0548	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.7500	10.6334	0.3000	0.0000	0.7700	6.7549	(74)
East	9.4500	19.6403	0.3000	0.0000	0.7700	42.8737	(76)
South	5.6100	46.7521	0.3000	0.0000	0.7700	60.5865	(78)
West	1.4400	19.6403	0.3000	0.0000	0.7700	6.5331	(80)

Solar gains	116.7482	208.7842	307.4997	410.2265	480.8206	485.3018	464.6759	411.7357	343.5284	237.0735	141.7532	98.6133	(83)
Total gains	822.4206	911.5923	986.6659	1046.1969	1073.2065	1035.7626	992.4819	943.4135	897.9857	834.4124	786.6375	784.6681	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.7840	52.0063	52.2306	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	
alpha	4.4523	4.4671	4.4820	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	
util living area	0.9916	0.9856	0.9717	0.9363	0.8561	0.7088	0.5446	0.5909	0.8091	0.9499	0.9855	0.9931	(86)
MIT	19.5555	19.7363	20.0303	20.3967	20.7150	20.9137	20.9793	20.9701	20.8370	20.4282	19.9295	19.5362	(87)
Th 2	20.0640	20.0677	20.0713	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	(88)
util rest of house	0.9895	0.9820	0.9644	0.9189	0.8157	0.6313	0.4393	0.4852	0.7448	0.9326	0.9812	0.9914	(89)
MIT 2	18.7477	18.9295	19.2220	19.5817	19.8731	20.0320	20.0714	20.0674	19.9795	19.6175	19.1307	18.7395	(90)
Living area fraction									fLA = Living area / (4) =			0.1827	(91)
MIT	18.8953	19.0769	19.3696	19.7306	20.0269	20.1931	20.2372	20.2323	20.1361	19.7656	19.2766	18.8850	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7453	18.9269	19.2196	19.5806	19.8769	20.0431	20.0872	20.0823	19.9861	19.6156	19.1266	18.7350	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9761	0.9557	0.9073	0.8056	0.6281	0.4404	0.4857	0.7374	0.9215	0.9752	0.9879	(94)
Useful gains	810.3761	889.8331	942.9843	949.2395	864.5300	650.5785	437.0626	458.2051	662.1637	768.9414	767.1332	775.1349	(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	1869.1611	1807.2623	1631.7959	1358.7401	1040.2320	692.4438	443.6279	468.4429	748.8073	1146.9218	1529.9745	1849.0880	(97)
Space heating kWh	787.7360	616.5124	512.4759	294.8405	130.7223	0.0000	0.0000	0.0000	0.0000	281.2174	549.2457	799.0211	(98a)
Space heating requirement - total per year (kWh/year)												3971.7713	
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	787.7360	616.5124	512.4759	294.8405	130.7223	0.0000	0.0000	0.0000	0.0000	281.2174	549.2457	799.0211	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3971.7713	
Space heating per m2											(98c) / (4) =	31.4073	(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 %)												89.0000	(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	787.7360	616.5124	512.4759	294.8405	130.7223	0.0000	0.0000	0.0000	0.0000	281.2174	549.2457	799.0211	(98)

Space heating efficiency (main heating system 1)

	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000 (210)

Space heating fuel (main heating system)

	885.0967	692.7106	575.8156	331.2814	146.8790	0.0000	0.0000	0.0000	0.0000	315.9746	617.1300	897.7765 (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

	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193 (64)

Efficiency of water heater 87.3000 (216)

(217)m	88.5851	88.5467	88.4636	88.3061	87.9841	87.3000	87.3000	87.3000	87.3000	88.2850	88.5110	88.5936 (217)

Fuel for water heating, kWh/month

	281.6459	248.3074	261.9510	225.8661	216.4064	192.8769	187.7619	197.3003	201.7582	226.7810	245.7675	277.9200 (219)

Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	12.3475	11.1526	12.3475	11.9492	12.3475	11.9492	12.3475	12.3475	11.9492	12.3475	11.9492	12.3475 (231)
Lighting	36.7733	29.5009	26.5623	19.4607	15.0320	12.2813	13.7127	17.8243	23.1520	30.3766	34.3103	37.7954 (232)

Electricity generated by PVs (Appendix M) (negative quantity)

(233a)m	-47.3599	-71.0947	-108.6973	-126.2305	-136.5794	-127.2615	-125.3262	-117.9847	-103.6588	-83.3432	-53.1476	-40.1117 (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	-25.7915	-61.0977	-140.6494	-238.6697	-337.6672	-347.8098	-339.8020	-273.3824	-181.1778	-92.4874	-35.6816	-19.6774 (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 4462.6644 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 87.3000
Water heating fuel used 2764.3425 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543)
mechanical ventilation fans (SFP = 0.1543) 59.3821 (230a)
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 145.3821 (231)
Electricity for lighting (calculated in Appendix L) 296.7817 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -3234.6895 (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 4434.4814 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4462.6644	3.6400	162.4410	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2764.3425	3.6400	100.6221	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	145.3821	16.4900	23.9735	(249)
Energy for lighting	296.7817	16.4900	48.9393	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1140.7956	16.4900	-188.1172	
PV Unit electricity exported	-2093.8939	5.5900	-117.0487	
Total			-305.1659	(252)
Total energy cost			122.8100	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.3600 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.2579 (257)
SAP value 95.8202
SAP rating (Section 12) 96 (258)
SAP band A

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	4462.6644	0.2100	937.1595	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2764.3425	0.2100	580.5119	(264)
Space and water heating			1517.6715	(265)
Pumps, fans and electric keep-hot	145.3821	0.1387	20.1663	(267)
Energy for lighting	296.7817	0.1443	42.8348	(268)
Energy saving/generation technologies				

PV Unit electricity used in dwelling	-1140.7956	0.1339	-152.7464	
PV Unit electricity exported	-2093.8939	0.1230	-257.5065	
Total			-410.2529	(269)
Total CO2, kg/year			1170.4196	(272)
CO2 emissions per m2			9.2600	(273)
EI value			90.8529	
EI rating			91	(274)
EI band			B	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.2300 (1b)	x	2.3100 (2b)	=	146.0613	(1b) - (3b)
First floor	63.2300 (1c)	x	2.6800 (2c)	=	169.4564	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	126.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	315.5177	(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	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
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		5.0000 (17)
Infiltration rate		0.2500 (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) =	0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.1000	4.1000	3.9000	3.7000	3.2000	3.3000	3.2000	3.3000	3.5000	3.7000	3.9000	(22)
Wind factor	1.0500	1.0250	1.0250	0.9750	0.9250	0.8000	0.8250	0.8000	0.8250	0.8750	0.9250	0.9750	(22a)
Adj infilt rate	0.2231	0.2178	0.2178	0.2072	0.1966	0.1700	0.1753	0.1700	0.1753	0.1859	0.1966	0.2072	(22b)

Mechanical extract ventilation - decentralised		
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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Door			4.0500	1.0000	4.0500			(26)
Window (Uw = 1.20)			19.2500	1.1450	22.0420			(27)
GF			63.2300	0.1100	6.9553	75.0000	4742.2500	(28a)
Main	167.8137	23.3000	144.5137	0.1800	26.0125	110.0000	15896.5070	(29a)
PIJ	63.2300		63.2300	0.1000	6.3230	9.0000	569.0700	(30)
Total net area of external elements Aum(A, m2)			294.2737					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.3828			(33)
Internal Wall 1			134.1400			9.0000	1207.2600	(32c)
Internal Floor 1			63.2300			18.0000	1138.1400	(32d)
Internal Ceiling 1			63.2300			9.0000	569.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	24122.2970 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		190.7504 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	18.4200	0.0500	0.9210
E3 Sill	18.4200	0.0200	0.3684
E4 Jamb	36.3000	0.0160	0.5808
E5 Ground floor (normal)	33.6300	0.1080	3.6320
E6 Intermediate floor within a dwelling	33.6300	0.0000	0.0000
E16 Corner (normal)	29.9400	0.0510	1.5269
E17 Corner (inverted - internal area greater than external area)	9.9800	-0.0700	-0.6986
E10 Eaves (insulation at ceiling level)	18.9300	0.1220	2.3095
E12 Gable (insulation at ceiling level)	14.7100	0.0770	1.1327

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.7727 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	75.1555 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	52.0604	(38)
Heat transfer coeff	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	127.2159	(39)
Average = Sum(39)m / 12 =												127.2159	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	1.0060	(40)
HLP (average)												1.0060	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8852	(42)
Hot water usage for mixer showers													
	72.5949	71.5039	69.9142	66.8725	64.6278	62.1246	60.7017	62.2794	64.0089	66.6966	69.8036	72.3167	(42a)
Hot water usage for baths													
	31.3414	30.8759	30.2205	29.0119	28.1069	27.1035	26.5615	27.2123	27.9210	28.9948	30.2282	31.2354	(42b)
Hot water usage for other uses													
	44.1772	42.5707	40.9643	39.3578	37.7514	36.1450	36.1450	37.7514	39.3578	40.9643	42.5707	44.1772	(42c)
Average daily hot water use (litres/day)												136.1495	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	148.1135	144.9506	141.0989	135.2422	130.4862	125.3730	123.4081	127.2432	131.2878	136.6557	142.6026	147.7294	(44)
Energy conte	234.5755	206.4077	216.8638	185.1399	175.6594	154.1607	149.2514	157.5536	161.8909	185.4405	203.1636	231.3085	(45)
Energy content (annual)										Total = Sum(45)m =		2261.4156	
Distribution loss (46)m = 0.15 x (45)m													
	35.1863	30.9612	32.5296	27.7710	26.3489	23.1241	22.3877	23.6330	24.2836	27.8161	30.4745	34.6963	(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	14.9206	13.4603	14.8675	14.3137	14.7439	14.2208	14.6647	14.6896	14.2440	14.7732	14.3678	14.9108	(61)
Total heat required for water heating calculated for each month													
	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(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													
	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)
										Total per year (kWh/year) = Sum(64)m =		2435.5925	(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													
	81.7265	71.9956	75.8241	65.1374	62.0927	54.8136	53.2923	56.0590	57.3897	65.3523	71.1438	80.6378	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	173.1111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	42.0125	37.3152	30.3467	22.9744	17.1736	14.4987	15.6664	20.3637	27.3322	34.7045	40.5053	43.1802	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	437.9124	442.4566	431.0054	406.6273	375.8543	346.9320	327.6102	323.0660	334.5172	358.8953	389.6683	418.5905	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	55.1963	(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)													
	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	-115.4074	(71)
Water heating gains (Table 5)													
	109.8475	107.1364	101.9141	90.4687	83.4580	76.1300	71.6294	75.3481	79.7080	87.8391	98.8109	108.3841	(72)
Total internal gains													
	705.6724	702.8081	679.1662	635.9704	592.3859	550.4608	527.8059	531.6778	554.4573	597.3388	644.8844	686.0548	(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	2.7500	9.8154	0.3000	0.0000	0.7700	6.2353	(74)
East	9.4500	18.1295	0.3000	0.0000	0.7700	39.5757	(76)
South	5.6100	43.1558	0.3000	0.0000	0.7700	55.9260	(78)
West	1.4400	18.1295	0.3000	0.0000	0.7700	6.0306	(80)

Solar gains	107.7676	197.1851	285.0778	382.8781	460.7864	461.0367	445.0071	388.1330	325.6052	226.2975	133.1621	98.6133	(83)
Total gains	813.4399	899.9931	964.2441	1018.8485	1053.1724	1011.4975	972.8130	919.8109	880.0625	823.6363	778.0464	784.6681	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	52.6714	
alpha	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	4.5114	
util living area													
	0.9910	0.9851	0.9709	0.9349	0.8469	0.6718	0.5093	0.5472	0.7988	0.9488	0.9849	0.9926	(86)
MIT	19.6338	19.7891	20.0757	20.4223	20.7410	20.9371	20.9855	20.9803	20.8527	20.4437	19.9610	19.5769	(87)
Th 2	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	20.0784	(88)
util rest of house													
	0.9888	0.9814	0.9632	0.9165	0.8031	0.5855	0.3986	0.4335	0.7298	0.9309	0.9803	0.9907	(89)

MIT 2	18.8365	18.9902	19.2724	19.6068	19.8960	20.0477	20.0742	20.0723	19.9920	19.6325	19.1620	18.7801	(90)
Living area fraction										fLA = Living area / (4) =		0.1827	(91)
MIT	18.9822	19.1361	19.4191	19.7558	20.0504	20.2102	20.2406	20.2382	20.1492	19.7807	19.3079	18.9256	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8322	18.9861	19.2691	19.6058	19.9004	20.0602	20.0906	20.0882	19.9992	19.6307	19.1579	18.7756	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9845	0.9754	0.9544	0.9048	0.7934	0.5836	0.4001	0.4347	0.7230	0.9197	0.9742	0.9870	(94)
Useful gains	800.8384	877.8319	920.3070	921.8957	835.5771	590.3527	389.2190	399.8834	636.3269	757.5023	757.9341	774.4571	(95)
Ext temp.	4.7000	5.2000	6.9000	9.3000	12.1000	15.2000	17.0000	16.9000	14.4000	10.8000	7.4000	4.5000	(96)
Heat loss rate W	1797.8358	1753.8099	1573.5486	1311.0600	992.3307	618.2947	393.1791	405.5848	712.3134	1123.4007	1495.7978	1816.0880	(97)
Space heating kWh	741.7661	588.6572	486.0118	280.1983	116.6247	0.0000	0.0000	0.0000	0.0000	272.2284	531.2619	774.9734	(98a)
Space heating requirement - total per year (kWh/year)												3791.7217	
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	741.7661	588.6572	486.0118	280.1983	116.6247	0.0000	0.0000	0.0000	0.0000	272.2284	531.2619	774.9734	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3791.7217	
Space heating per m2											(98c) / (4) =	29.9836	(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 %)												89.0000	(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	741.7661	588.6572	486.0118	280.1983	116.6247	0.0000	0.0000	0.0000	0.0000	272.2284	531.2619	774.9734	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	833.4450	661.4126	546.0806	314.8296	131.0389	0.0000	0.0000	0.0000	0.0000	305.8746	596.9234	870.7567	(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	249.4962	219.8680	231.7313	199.4536	190.4033	168.3815	163.9161	172.2432	176.1349	200.2137	217.5313	246.2193	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.5659	88.5312	88.4439	88.2851	87.9380	87.3000	87.3000	87.3000	87.3000	88.2715	88.4993	88.5841	(217)
Fuel for water heating, kWh/month	281.7068	248.3509	262.0093	225.9199	216.5199	192.8769	187.7619	197.3003	201.7582	226.8157	245.7999	277.9498	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	12.3475	11.1526	12.3475	11.9492	12.3475	11.9492	12.3475	12.3475	11.9492	12.3475	11.9492	12.3475	(231)
Lighting	36.7733	29.5009	26.5623	19.4607	15.0320	12.2813	13.7127	17.8243	23.1520	30.3766	34.3103	37.7954	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-44.4852	-68.3546	-103.9972	-122.2281	-134.4412	-125.0893	-123.5116	-115.2557	-100.9699	-80.9624	-50.7394	-40.1117	(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	-23.0391	-56.4938	-127.1679	-218.3455	-320.0452	-326.2284	-321.9287	-253.6763	-169.0056	-86.8759	-32.7062	-19.6774	(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	4260.3615	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	87.3000	
Water heating fuel used	2764.7694	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 6.9420, total flow = 45.0000, SFP = 0.1543)		
mechanical ventilation fans (SFP = 0.1543)	59.3821	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	145.3821	(231)
Electricity for lighting (calculated in Appendix L)	296.7817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3065.3364	(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	4401.9583	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4260.3615	4.8000	204.4974	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2764.7694	4.8000	132.7089	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	145.3821	21.5100	31.2717	(249)
Energy for lighting	296.7817	21.5100	63.8378	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1110.1463	21.5100	-238.7925	
PV Unit electricity exported	-1955.1901	5.5900	-109.2951	
Total			-348.0876	(252)
Total energy cost			182.2281	(255)

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	4260.3615	0.2100	894.6759	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2764.7694	0.2100	580.6016	(264)
Space and water heating			1475.2775	(265)
Pumps, fans and electric keep-hot	145.3821	0.1387	20.1663	(267)
Energy for lighting	296.7817	0.1443	42.8348	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1110.1463	0.1338	-148.4825	
PV Unit electricity exported	-1955.1901	0.1227	-239.9694	
Total			-388.4519	(269)
Total CO2, kg/year			1149.8267	(272)

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	4260.3615	1.1300	4814.2085	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2764.7694	1.1300	3124.1894	(278)
Space and water heating			7938.3978	(279)
Pumps, fans and electric keep-hot	145.3821	1.5128	219.9341	(281)
Energy for lighting	296.7817	1.5338	455.2138	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1110.1463	1.4943	-1658.8701	
PV Unit electricity exported	-1955.1901	0.4504	-880.5495	
Total			-2539.4196	(283)
Total Primary energy kWh/year			6074.1260	(286)

10 Bibliography and definitions

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SAP	Standard Assessment Procedure
ENE 1	Energy 1
ENE 7	Energy 7
SAP	Standard Assessment Procedure
LZC	Low or Zero Carbon Technology
CSH	Code for Sustainable Homes
EI	Environmental Impact
FIT	Feed in Tariffs
RHI	Renewable Heat Incentives
DER	Dwelling Emission Rate
TER	Target Emission Rate
DNO	District Network Operator
PV	Photovoltaic
CHP	Combined Heat and Power
AD	Anaerobic Digestion
ASHP	Air Source Heat Pump
GSHP	Ground Source Heat Pump