

Land adj to 220 Ainsworth Road, BURY, BL8 2LR

Energy Statement

&

**Regulation 25a Low or Zero Carbon (LZC) technology feasibility
study**

AG-79053-LZCR-Rev A

1st August 2025

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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 152.83% reduction in Carbon emissions over and above AD. L1 2013 requirements (Regulated use).

Regulated use

Energy (Consumption)	138.60%
Primary Energy (Total energy)	99.33%
Carbon emissions	121.83% (AD. Part L1 2021)
Carbon emissions	152.83% (AD. Part L1 2013)

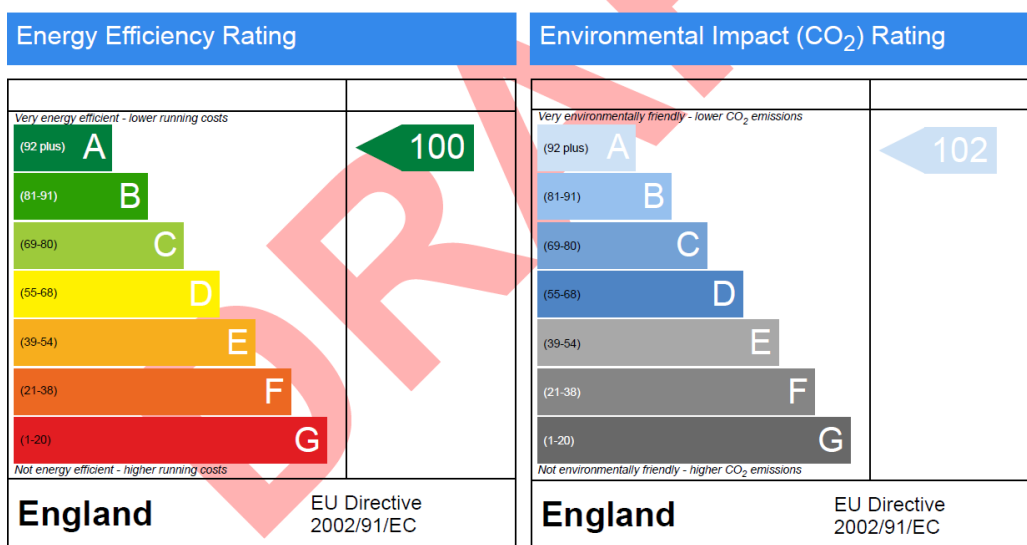
Total use

Energy (Consumption)	73.77%
Primary Energy (Total energy)	45.95%
Carbon emissions	81.38%

Residual Carbon Emissions 311.70 Kg CO₂ per Year

Proposed Solution

The proposed solution which is shown on page 6 of this report is to adopt a Fabric First approach in terms of build U-Values (Be Lean), use High Efficient Heat Pump Technology (Be Clean) and install Photovoltaic technology (Be Green) and meet the regulatory requirements of Approved Document Part L Volume 1 of the Building Regulations 2021.

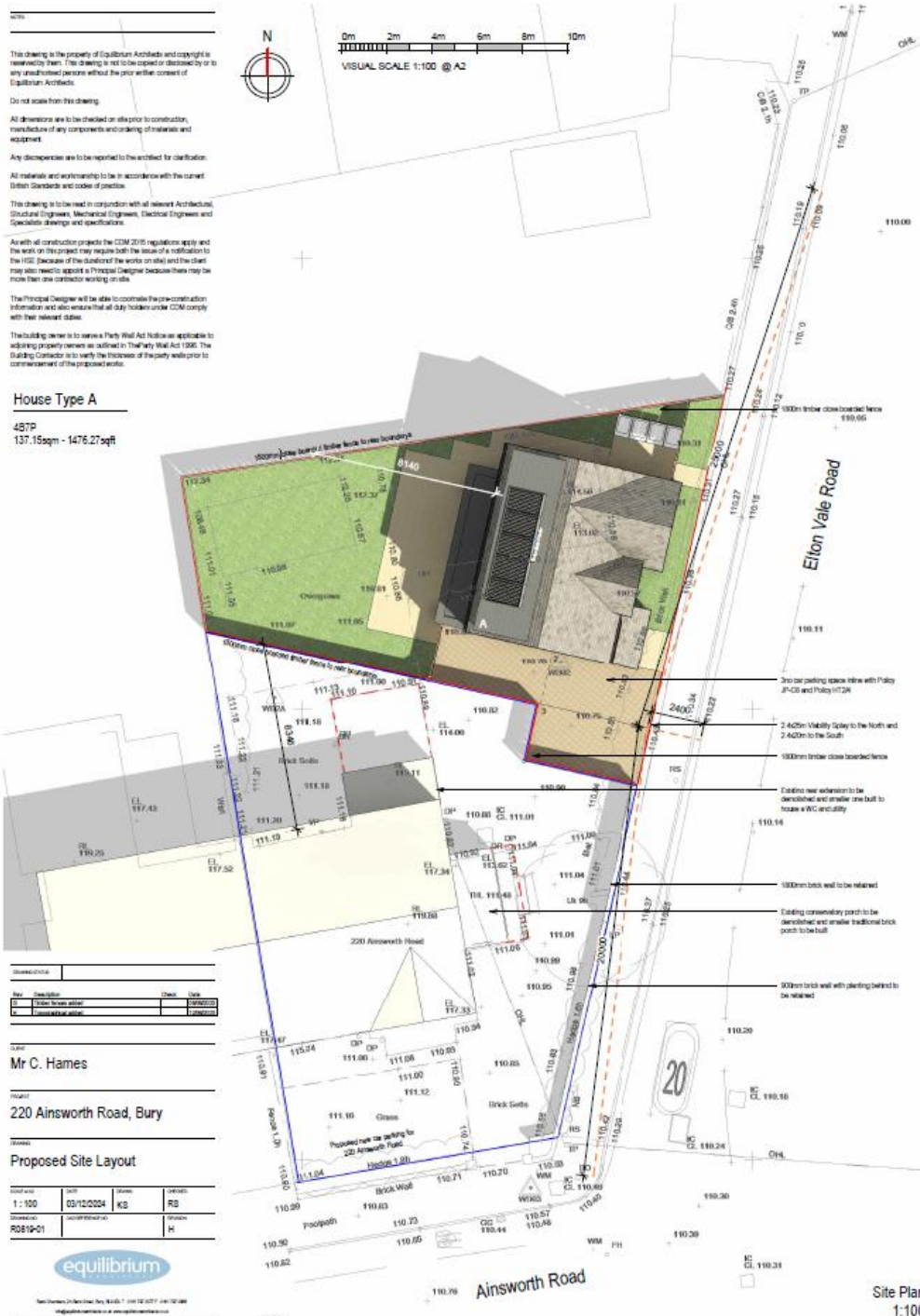


The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

2. The development

The residential development at Land adj to 220 Ainsworth Road, BURY, BL8 2LR will comprises of a single dwelling which are to achieve compliance with approved document Part L1 of the building regulations 2021.



2.1. Housing mix

House types	Number	GIFA sqft	Area m ²	Total area m ²
House Type A	1		137.15	137.15
Total	1			137.15

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/m ² K
Walls	0.18	W/m ² K
Floor	0.11	W/m ² K
Windows	1.20	W/m ² K
Doors	1.00	W/m ² K
Thermal Bridging	Modelled Thermal bridging details	
Air permeability	4 m ²	

Table 3: Mechanical Specification

Heating	Air Source Heat Pump, Vaillant or similar
Controls	Time and Temperature Zone Control
Domestic Hot Water	From main system
Compensator	Delayed start thermostat
Ventilation	Decentralised, Mechanical Extract Ventilation dMEV
Lighting	80lumes / watt
Photovoltaic Panels	6Kw Peak of PV panels

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

Development (Proposed)		m ²
GIFA (Development)		137.15
Energy		KwH
Heating		1,314.28
Hot water		999.11
Fans and Pumps		45.21
Lighting		204.23
Appliances		3,498.65
Cooking		588.09
Total Energy use		6,649.58
Energy Kw per m ² of floor area		48.48
Energy (Primary)		Kwpe
Heating		1,972.73
Hot water		1,499.66
Fans and Pumps		67.86
Lighting		306.55
Appliances		5,251.48
Cooking		882.73
Total Energy use		9,981.02
Energy Kw per m ² of floor area		72.77
CO2 emissions		Kg CO2
Heating		178.74
Hot water		135.88
Fans and Pumps		6.15
Lighting		27.78
Appliances		475.82
Cooking		79.98
Total CO2 emissions		904.34
Annual predicted carbon emissions per m ² of floor area		6.59
Running Cost		£ pa
Heating		£ 348.02
Hot water		£ 264.56
Fans and Pumps		£ 11.97
Lighting		£ 54.08
Appliances		£ 926.44
Cooking		£ 155.73
Standing Charges		£ 290.88
Total Running Costs		£ 2,051.69
Average annual Running Costs per residential unit		£ 2,051.69

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	3,622.04	1,314.28
Hot water	2,945.02	999.11
Fans and Pumps	86.00	45.21
Lighting	206.36	204.23
Appliances	3,498.65	3,498.65
Cooking	588.09	588.09
Photovoltaic (electricity used in dwelling)	-872.21	-1,416.68
Photovoltaic (electricity exported)	-1,337.20	-2,941.02
Total	8,736.76	2,291.88
Reduction in energy		6444.88
Percentage reduction		73.77%

Energy Primary (Kwpe)	NOTIONAL	PROPOSED
Heating	4,092.91	1,972.73
Hot water	3,327.87	1,499.66
Fans and Pumps	129.09	67.86
Lighting	309.75	306.55
Appliances	5,251.48	5,251.48
Cooking	882.73	882.73
Photovoltaic (electricity used in dwelling)	-1,309.19	-2,126.44
Photovoltaic (electricity exported)	-601.74	-1,323.46
Total	12,082.89	6,531.12
Reduction in energy		5551.77
Percentage reduction		45.95%

Carbon emissions (Kg/CO2)	NOTIONAL	PROPOSED
Heating	760.63	178.74
Hot water	618.45	135.88
Fans and Pumps	11.70	6.15
Lighting	28.06	27.78
Appliances	475.82	475.82
Cooking	79.98	79.98
Photovoltaic (electricity used in dwelling)	-118.62	-192.67
Photovoltaic (electricity exported)	-181.86	-399.98
Total	1,674.16	311.70
Reduction in Carbon emissions		1362.47
Percentage reduction		81.38%

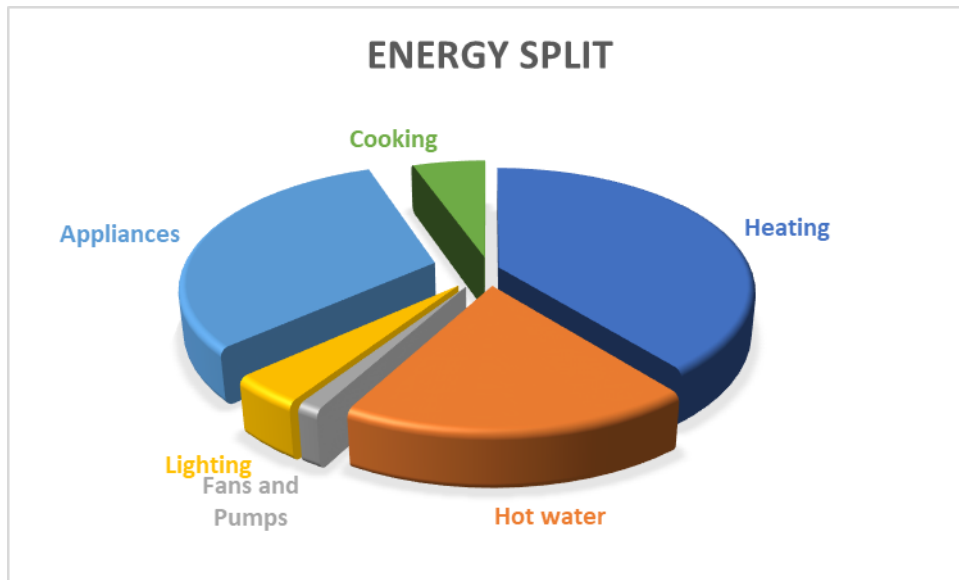
Reduction from Technologies

Energy	Kwh
Heating	1,314.28
Hot water	999.11
Fans and Pumps	45.21
Lighting	204.23
Appliances	3,498.65
Cooking	588.09
Sub TOTAL	6,649.58
Reduction in energy through LDC technology	-4,357.70
Total	2,291.88
Percentage reduction	65.53%

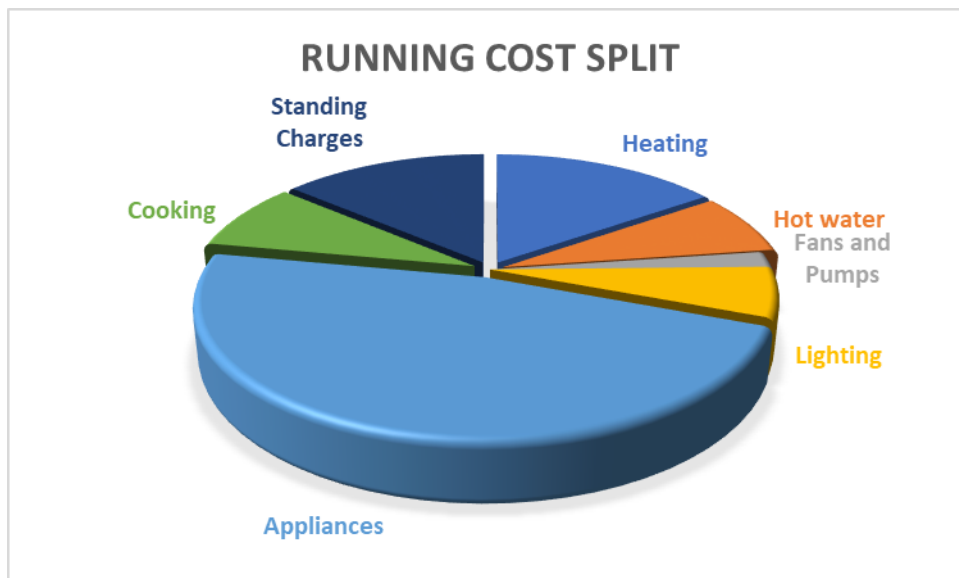
Energy (Primary)	Kwpe
Heating	1,972.73
Hot water	1,499.66
Fans and Pumps	67.86
Lighting	306.55
Appliances	5,251.48
Cooking	882.73
Sub TOTAL	9,981.02
Reduction in PRIMARY energy through LDC technology	-3,449.90
Total	6,531.12
Percentage reduction	34.56%

Carbon emissions	Kg/CO2
Heating	178.74
Hot water	135.88
Fans and Pumps	6.15
Lighting	27.78
Appliances	475.82
Cooking	79.98
Sub TOTAL	904.34
Reduction in Carbon emissions through LDC technology	-592.65
Total	311.70
Percentage reduction	65.53%

Total energy consumption split by use

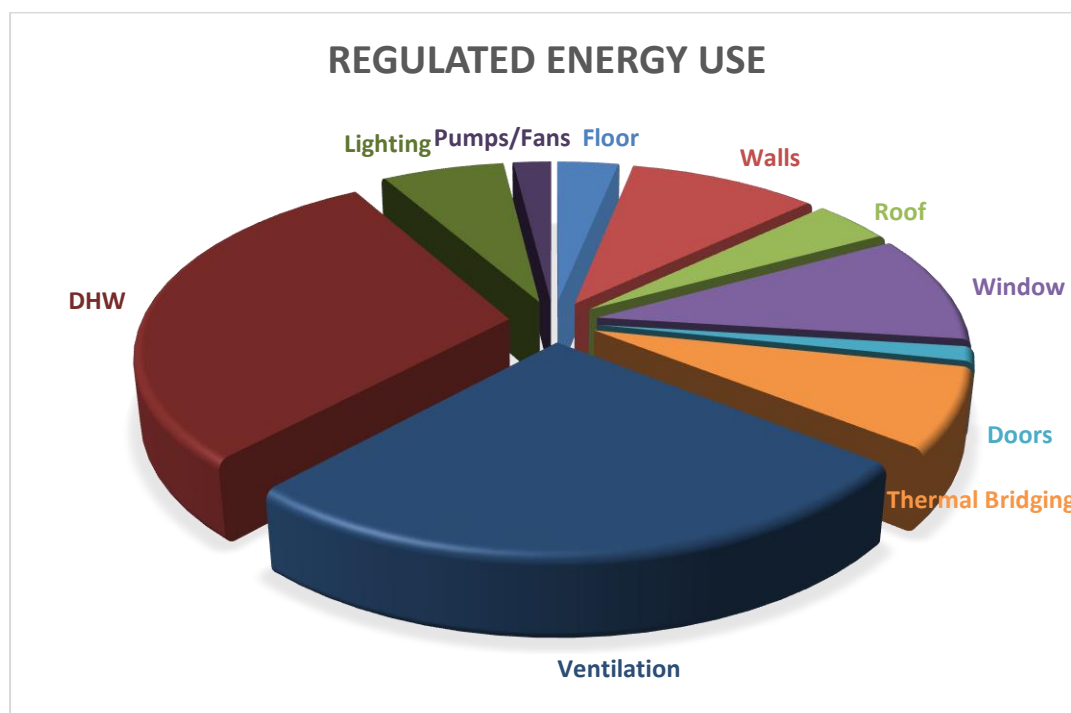


Total running cost split by use (Post April 2022 price cap)



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 CO₂ 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.

3. Introduction

Anderson Goddard Ltd has been commissioned by Equilibrium Architects Ltd to provide an Energy Statement and Low or Zero Carbon (LZC) feasibility assessment for the proposed development at the Land adj to 220 Ainsworth Road, BURY, BL8 2LR Fieldside, Crowle, SCUNTHORPE, DN17 4HH. 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

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

$$E_a \times E_{\text{Electricity}} / TFA$$

Where 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 CO₂ reduction provided by upgrade measures or LZC technologies including heating and innovative technologies will be assessed as a percentage of the total estimated CO₂ emissions which will include heating, ventilation, lighting, pumps and fans from SAP 2005 and also CO₂ 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.

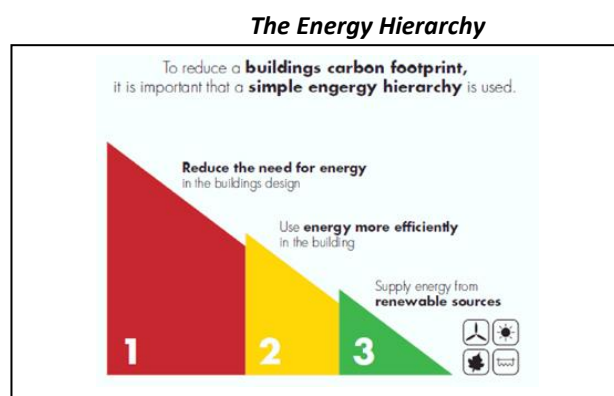
A SAP rating is an indication of heating and lighting costs, the higher the rating the lower the fuel costs will be.

Environmental Impact (EI) rating is an indication of CO₂ 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.



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 CO₂ 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	$U = 0.18 \text{ W/(m}^2\text{K)}$
Party walls	$U = 0$
Floors	$U = 0.13 \text{ W/(m}^2\text{K)}$
Roofs	$U = 0.11 \text{ W/(m}^2\text{K)}$
Opaque door (less than 30% glazed area)	$U = 1.0 \text{ W/(m}^2\text{K)}$
Semi-glazed door (30–60% glazed area)	$U = 1.0 \text{ W/(m}^2\text{K)}$
Windows and glazed doors with greater than 60% glazed area	$U = 1.2 \text{ W/(m}^2\text{K)}$ Frame factor = 0.7
Roof windows	$U = 1.2 \text{ W/(m}^2\text{K)}$, when in vertical position (for correction due to angle, see specification in SAP 10 Appendix R)
Rooflights	$U = 1.7 \text{ W/(m}^2\text{K)}$, 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	$5 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ 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 = $0.85 \times (0.2 + 0.051 V^{2/3}) \text{ kWh/day}$ where V is the volume of the cylinder in litres
Lighting	Fixed lighting capacity (lm) = 185 × 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 × 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.

3.4 Sustainability

Water Consumption

Wholesome water consumption will be limited to less than 110Litres per person per day

Installation Type	Unit	Capacity / Flow Rate	Use Factor	Fixed Uses	Litres/ Person / Day
WCs (Multiple fittings)	Full flush volume (litres)	3.06	4.42	0	13.53
Taps (Excluding Kitchen and utility)	Flow Rate (litres / minute)	6.00	1.58	1.58	11.06
Bath (Where shower is also present)	Capacity to overflow (litres)	170.00	0.11	0	18.70
Shower (Where bath is also present)	Flow Rate (litres / minute)	8.00	4.37	0	34.96
Bath only	Capacity to overflow (litres)		0.50	0	0.00
Shower only	Flow Rate (litres / minute)		5.60	0	0.00
Kitchen/Utility Tap	Flow Rate (litres / minute)	8.00	0.44	10.36	13.88
Washing Machine	Litres / kg dry load	8.17	2.1	0	17.16
Dishwasher	Litres / place setting	1.25	3.6	0	4.50
Waste Disposal	Litres / use		3.08	0	0.00
Water Softener	Litres / person / day		1	0	0.00
Total (Litres/Person/Day)					113.79
Contribution from grey water (litres/Person/Day)					0.00
Contribution from rainwater (litres/Person/Day)					0.00
Normalisation Factor					0.91
Total (Litres / person / day)					103.55
External water use (litres/Person/Day)					5.00
Total (Litres/person/day) (Total + External use)					108.55

Waste Management

Responsibilities

- All employees should take responsibility in proper disposal of waste
- External contractors must take responsibility in disposing of their wastes effectively either by following waste procedure or taking the waste with them off site.
- Those in management position (including Team Leaders) should take extra care to ensure that their employees are disposing of waste correctly, this includes providing any training where necessary.
- All employees should collaborate to find the most sustainable methods of managing waste as far as reasonably practicable.

Definitions

- Waste: A material or substance that is eliminated or discarded as no longer useful or required after the completion of a process.
- General waste: Any waste that is not currently segregated within waste streams.
- Hazardous waste: Any waste that is considered harmful to humans and/or the environment.
- Recyclable waste: Any waste materials that are able to be converted into usable objects to prevent wastage of material resources and consumption of fresh raw materials.
- Environmental Impact: Activities, products or services that interacts or can interact with the environment

Environmental policy

In order to minimise environmental impacts concerning our activities products and services

The organization shall:

- Comply with applicable legal obligations and other related requirements to which the company subscribes which relate to its environmental aspects.
- To include the consideration of its environmental issues in all business strategies and initiatives
- Be committed to ensure that the protection of the environment is firmly embedded in both the company's and all employees culture and will endeavor to influence its suppliers and customers in a similar strategic environmental manner.
- Prevent pollution, reduce waste and minimise the consumption of resources.
- Consider the wider global impact of all our activities including those of our suppliers' customers and stakeholders
- Continually drive improvement of the environmental management system.
- Educate, train and motivate employees to carry out tasks in an environmentally responsible manner and maintain a continuous professional development strategy
- Encourage environmental protection amongst suppliers and subcontractors
- To investigate the feasibility of influencing its suppliers' customers and third parties with consideration to life cycle impacts of the aspects and activities.
- Encourage and enhance biodiversity and ecology
- Ensure the policy is communicated to employees and relevant third parties. The organisation requires and expects all persons who are employed by the organisation including contractors and visitors to co-operate with and conform to this Policy.
- Ensure that all staff, contractors and others have access to this policy.

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 by 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 CO₂ 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.

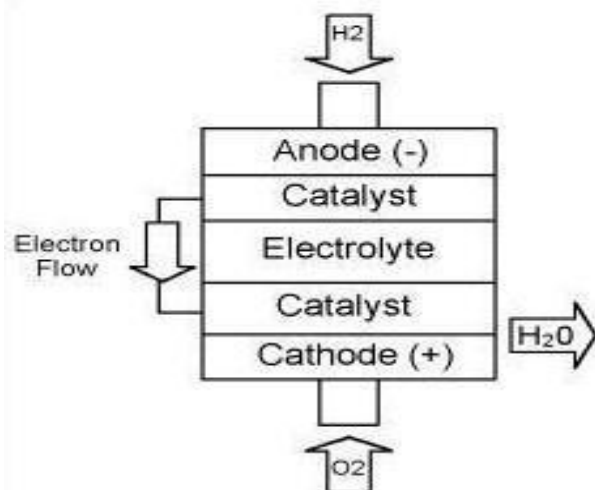
Another very important difference is that fuel cells do not run down like batteries. As long as the fuel and oxygen is supplied to the cell it will keep producing electricity for ever.

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 LDC technologies; in reality they provide a large reduction in both CO₂ 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 CO₂ emissions compared to some technologies that are classified and listed as LDC technologies yet do not provide a reduction in CO₂ 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 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.

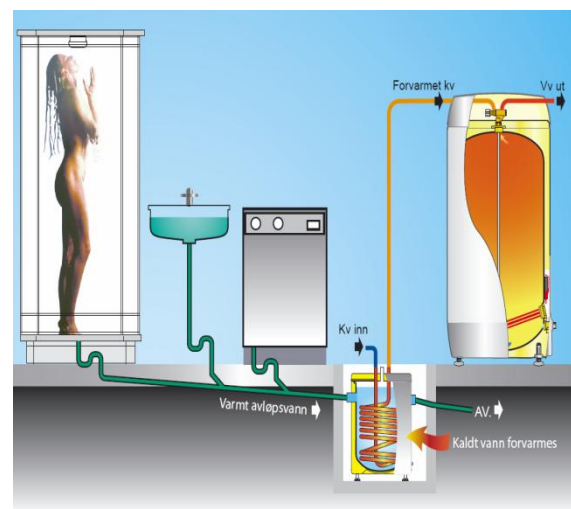
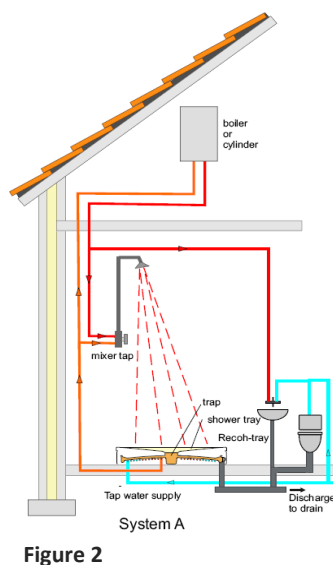
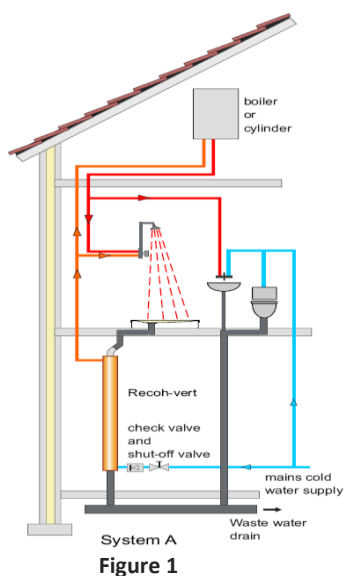
Land use

FGHRS requires no specific land use requirements.

Planning

FGHRS require no additional planning requirements.

5.2 Waste Water Heat Recovery Systems (WWHRs)



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 Reco-h-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.

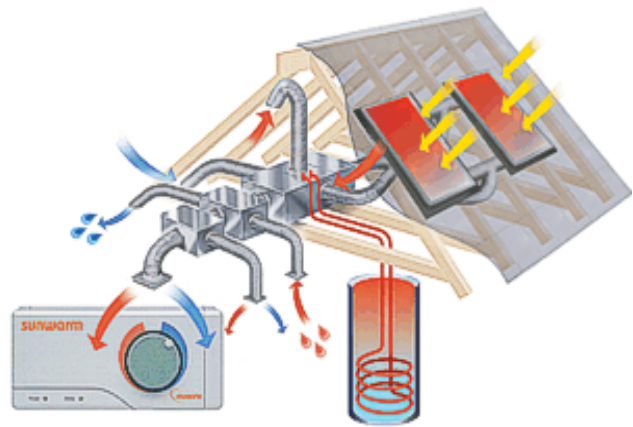
Whilst technically applicable to instantaneous electric showers, these aren't currently modelled by SAP, so it is not possible to apply in Appendix Q either.

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/ CO₂ 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.

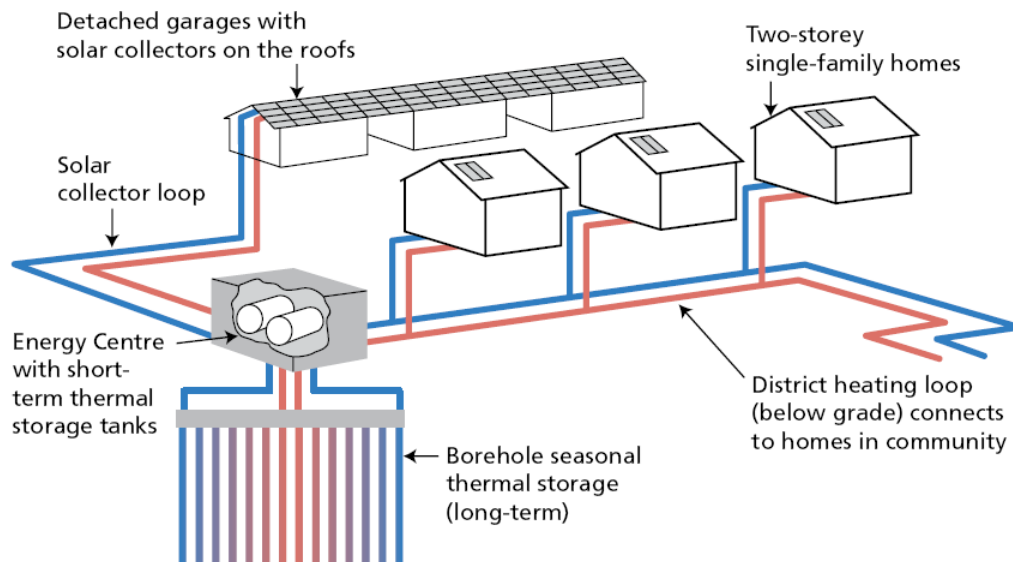
The Sunwarm system is a system that uses solar radiation in the same way Solar thermal uses solar radiation to heat water, the Sunwarm system uses solar radiation to heat air which is then introduced through the ventilation ducting and into the dwelling, the Sunwarm system can also be used to heat water 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 approximately 1500 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 Geothermal Storage

Solar Seasonal Storage and District Loop



Geothermal 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.

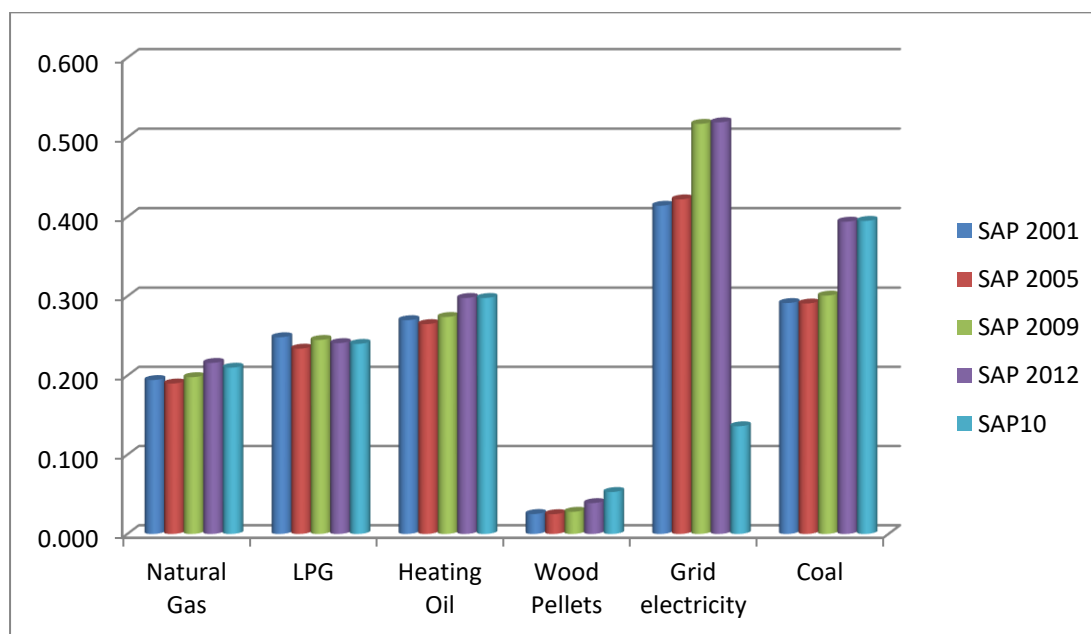
Currently there is no way of assessing the benefit of the Geothermal storage system because of limited test data and therefore the system has not been considered further in this study.

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

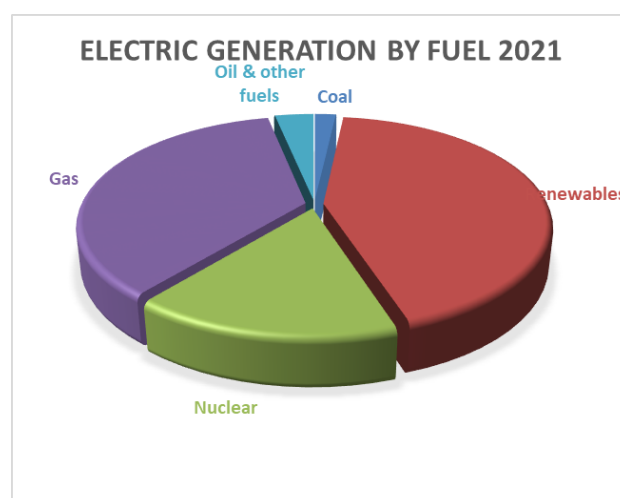
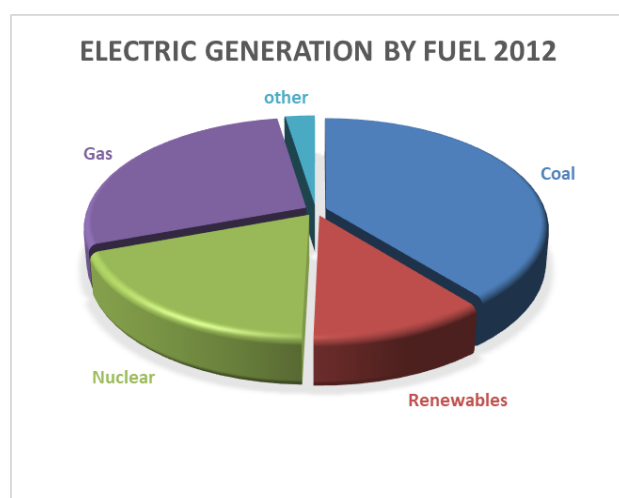
6 Fuel Cost and Carbon

Carbon

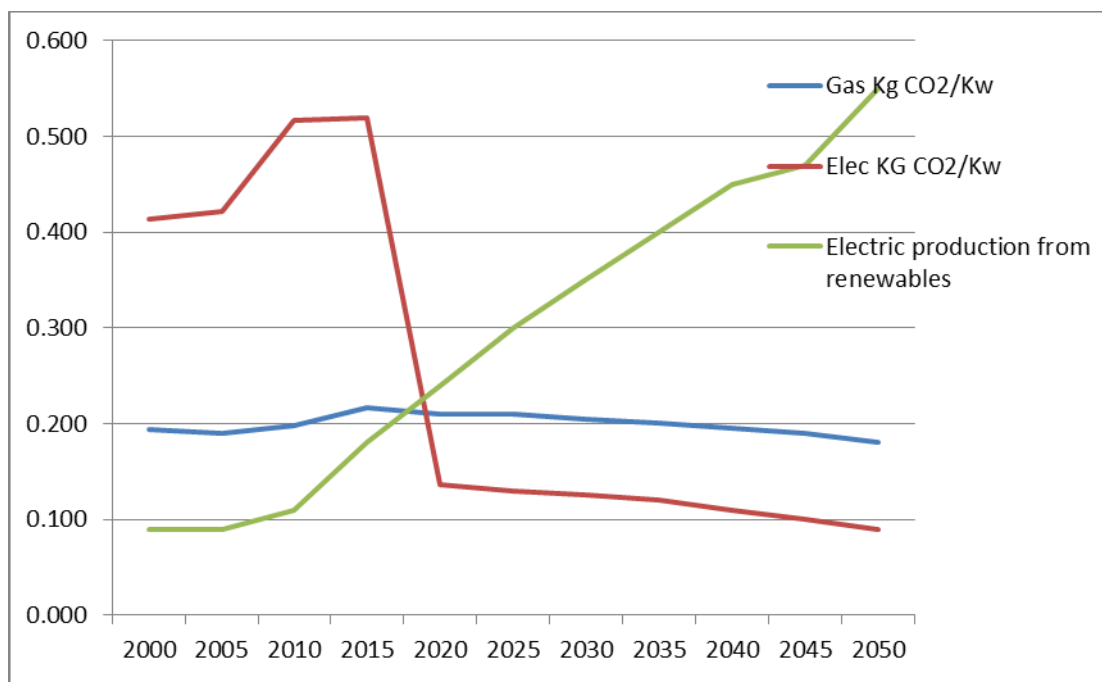
Carbon factors including SAP10.1 estimate, due to the decarbonisation of the grid electricity is now the low carbon fuel



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.

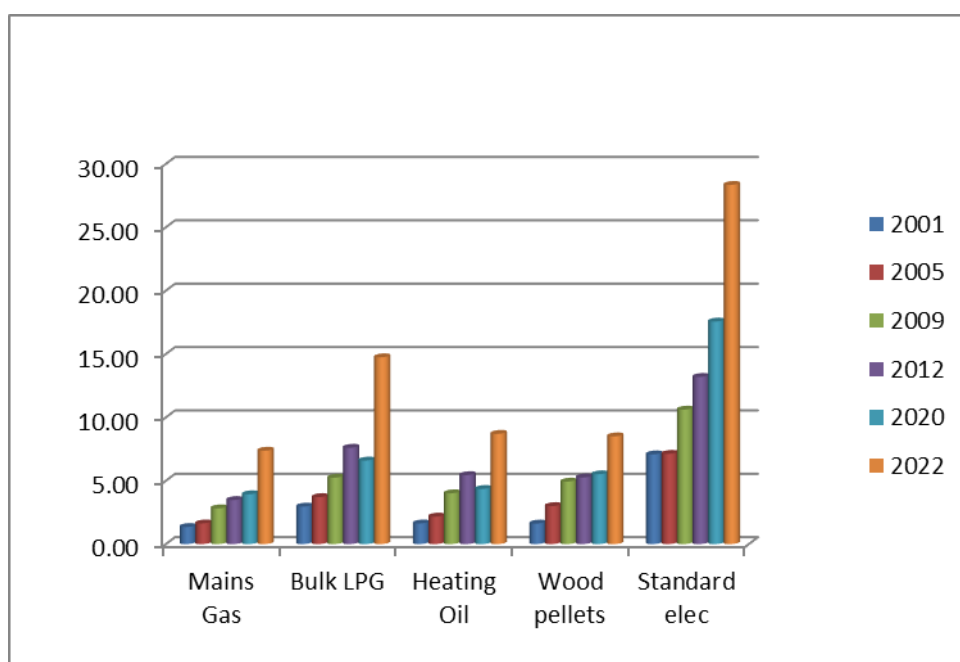


The following graph represents an estimate of CO₂ emissions for both gas and electricity and how they may change over the following years; data has been taken from SAP 2001, 2005, 2009, 2012 and SAP10.1 documents.



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

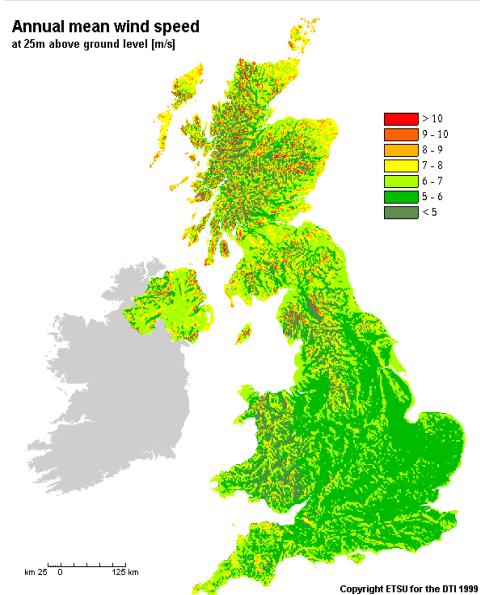
Low or Zero Carbon technologies and other innovative technologies not thought appropriate for use at the proposed development.

- 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 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 (PM₁₀/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 CO₂ 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 once 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 Bibliography and definitions

DCLG

<http://www.communities.gov.uk/corporate/>

Energy Saving Trust

<http://www.energysavingtrust.org.uk/>

Building Research Establishment (BRE)

<http://www.bre.co.uk/>

Code for Sustainable Homes (CSH) version 2 revised May 2009 incorporating 2014 addendum

<http://www.bre.co.uk/>

London Tool Kit 2004

SAP 2012 version 9.92 (BRE)

<http://projects.bre.co.uk/sap2012/>

Business Enterprise and Regulatory Reform (BERR)

Planning Portal

<http://www.planningportal.gov.uk/>

Department for Environment Food and Rural Affairs

DEFRA

<http://www.defra.gov.uk/>

NOABL database

BERR

<http://www.berr.gov.uk/whatwedo/energy/sources/renewables/explained/wind/windspeed-database/page27326.html>

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

10 Appendix A

Sample SAP calculation

- Dwelling Emission Rate (DER)
- Target Emission Rate (TER)
- Dwelling Fabric Energy Efficiency (DFEE)
- Target Fabric Energy Efficiency (TFEE)
- Dwelling Primary Energy Rate (DPER)
- Target Primary Energy Rate (TPER)
- Predictive Energy Assessment (PEA)
- Energy Report (ER)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Fri 01 Aug 2025 12:48:16

Project Information			
Assessed By	Paul Goddard	Building Type	House, Detached
OCDEA Registration	EES/005113	Assessment Date	2025-08-01

Dwelling Details			
Assessment Type	As designed	Total Floor Area	93 m ²
Site Reference	79053	Plot Reference	001
Address	Land adj to 220 Ainsworth Road, BURY, BL8 2LR		

Client Details	
Name	-
Company	-
Address	-, -, -, -

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	12.12 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	-1.79 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	63.38 kWh _{PE} /m ²		
Dwelling primary energy	5.86 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	43.5 kWh/m ²		
Dwelling fabric energy efficiency	43.2 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.18	Walls (1) (0.18)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.11	GF (0.11)	OK
Roofs	0.16	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	1.6	1.18	Front (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	122.59	0.18	
Ground floor: GF, GF	46.37	0.11	
Exposed roof: Roof (1)	46.37	0.1 (!)	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
Front , Window	6.35	East	1.0	1.2
Rear, Window	13.83	West	1.0	1.2
Door, Door	2.15	East	N/A	1 (!)
Side, Window	1.91	South	1.0	1.2
Side, Window	0.97	North	1.0	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	Thermally Broken
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	To be modelled

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.05	To be modelled
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0 (!)	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.05	To be modelled
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	To be modelled
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²		
Dwelling air permeability at 50Pa	4 m ³ /hm ² , Design value		OK
Air permeability test certificate reference			

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity

Efficiency	242.3%
Emitter type	Radiators
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Vaillant Group UK Ltd
Model	aroTHERM plus 5kW & AI 200l
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	1.22 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W		
Lowest light source efficacy	80 lm/W		OK
External lights control	N/A		

8 Mechanical ventilation		
System type: Decentralised mechanical extract		
Maximum permitted specific fan power	0.7 W/(l/s)	
Specific fan power	0.16 W/(l/s)	OK
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model	Lo-Carbon NBR dMEV C 100, 498095	
Commissioning		

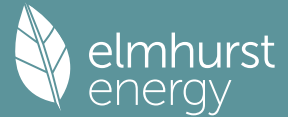
9 Local generation	
Technology type: Photovoltaic system (1)	
Peak power	6 kWp
Orientation	West
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks	
N/A	

11 Supporting documentary evidence	
N/A	

12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed:	Assessor ID:
Name:	Date:
b. Client Declaration	
N/A	

Full SAP Calculation Printout



Property Reference	79053				Issued on Date	01/08/2025	
Assessment Reference	001			Prop Type Ref			
Property	Land adj to , 220 Ainsworth Road, BURY, BL8 2LR						
SAP Rating	100 A	DER	-1.79	TER	12.12		
Environmental	102 A	% DER < TER				114.77	
CO ₂ Emissions (t/year)	-0.1	DFEE	43.17	TFEE	43.48		
Compliance Check	See BREL	% DFEE < TFEE				0.72	
% DPER < TPER	90.75	DPER	5.86	TPER	63.38		
Assessor Details	Mr. Paul Goddard				Assessor ID	B342-0001	
Client	-, -						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	46.3700 (1b)	x 2.4000 (2b)	= 111.2880 (1b) - (3b)
First floor	46.3700 (1c)	x 2.7000 (2c)	= 125.1990 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	236.4870 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2000 (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) = 0.1700 (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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												
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 m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Door			2.1500	1.0000	2.1500		(26)
Window			23.0600	1.1450	26.4046		(27)
GF			46.3700	0.1100	5.1007	75.0000	3477.7500 (28a)
Main	147.7980	25.2100	122.5880	0.1800	22.0658	110.0000	13484.6800 (29a)
Flat	46.3700		46.3700	0.1000	4.6370	9.0000	417.3300 (30)
Total net area of external elements A _{um} (A, m ²)			240.5380				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.3581		(33)
Main dwelling							
Internal Wall 1			555.4400			75.0000	41658.0002 (32c)
Internal Floor 1			46.3700			18.0000	834.6600 (32d)
Internal Ceiling 1			46.3700			9.0000	417.3300 (32e)
Heat capacity C _m = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	60289.7502 (34)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K							650.0944 (35)
List of Thermal Bridges							

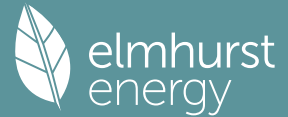
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 39.0204	Feb 39.0204	Mar 39.0204	Apr 39.0204	May 39.0204	Jun 39.0204	Jul 39.0204	Aug 39.0204	Sep 39.0204	Oct 39.0204	Nov 39.0204	Dec 39.0204 (38)
Heat transfer coeff	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131 (39)
Average = Sum(39)m / 12 =												109.6131
HLP	Jan 1.1819	Feb 1.1819	Mar 1.1819	Apr 1.1819	May 1.1819	Jun 1.1819	Jul 1.1819	Aug 1.1819	Sep 1.1819	Oct 1.1819	Nov 1.1819	Dec 1.1819 (40)
HLP (average)												1.1819
Days in month	31	28	31	30	31	30	31	31	30	31	30	31

Assumed occupancy													2.6614 (42)
Hot water usage for mixer showers	68.8427	67.8081	66.3005	63.4160	61.2874	58.9135	57.5642	59.0604	60.7004	63.2493	66.1957	68.5789	(42a)
Hot water usage for baths	29.7278	29.2863	28.6646	27.5182	26.6599	25.7081	25.1940	25.8113	26.4835	27.5020	28.6720	29.6273	(42b)
Hot water usage for other uses	41.8854	40.3623	38.8392	37.3161	35.7930	34.2699	34.2699	35.7930	37.3161	38.8392	40.3623	41.8854	(42c)
Average daily hot water use (litres/day)												129.1106	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	140.4558	137.4567	133.8043	128.2503	123.7402	118.8914	117.0280	120.6647	124.5000	129.5904	135.2299	140.0916	(44)
Energy content (annual)	222.4477	195.7365	205.6522	175.5683	166.5781	146.1909	141.5352	149.4080	153.5210	175.8530	192.6598	219.3496	(45)
Distribution loss (46)m = 0.15 x (45)m	33.3672	29.3605	30.8478	26.3352	24.9867	21.9286	21.2303	22.4112	23.0282	26.3779	28.8990	32.9024	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6588	(55)
Total storage loss	20.4228	18.4464	20.4228	19.7640	20.4228	19.7640	20.4228	20.4228	19.7640	20.4228	19.7640	20.4228	(56)
If cylinder contains dedicated solar storage	20.4228	18.4464	20.4228	19.7640	20.4228	19.7640	20.4228	20.4228	19.7640	20.4228	19.7640	20.4228	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	266.1329	235.1941	249.3374	217.8443	210.2633	188.4669	185.2204	193.0932	195.7970	219.5382	234.9358	263.0348	(62)
PV 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	(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)
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	(63c)
Output from w/h	266.1329	235.1941	249.3374	217.8443	210.2633	188.4669	185.2204	193.0932	195.7970	219.5382	234.9358	263.0348	(64)
12Total per year (kWh/year)												2659	(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	108.9120	96.6485	103.3275	92.1973	90.3354	82.4293	82.0086	84.6263	84.8665	93.4193	97.8802	107.8819	(65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	123.0847	136.2724	123.0847	127.1876	123.0847	127.1876	123.0847	123.0847	127.1876	123.0847	127.1876	123.0847 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.0293	246.5615	240.1803	226.5955	209.4470	193.3299	182.5627	180.0305	186.4117	199.9965	217.1449	233.2621 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070 (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)	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559 (71)
Water heating gains (Table 5)	146.3871	143.8221	138.8811	128.0518	121.4185	114.4851	110.2266	113.7451	117.8702	125.5635	135.9447	145.0025 (72)
Total internal gains	576.4221	589.5770	565.0671	544.7558	516.8713	497.9236	478.7951	479.7812	494.3904	511.5658	543.1982	564.2703 (73)

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.9700	10.6334	0.3300	0.0000	0.7700	2.6209 (74)
East	6.3500	19.6403	0.3300	0.0000	0.7700	31.6903 (76)
South	1.9100	46.7521	0.3300	0.0000	0.7700	22.6902 (78)
West	13.8300	19.6403	0.3300	0.0000	0.7700	69.0199 (80)

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Solar gains	126.0212	239.1798	380.2951	540.3590	654.0760	667.0077	635.9979	550.9844	437.0276	279.8129	155.7025	104.6105 (83)
Total gains	702.4434	828.7568	945.3622	1085.1148	1170.9472	1164.9312	1114.7930	1030.7656	931.4180	791.3787	698.9007	668.8808 (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	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843
alpha	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856
util living area	1.0000	0.9999	0.9988	0.9789	0.8413	0.6014	0.4326	0.4891	0.7959	0.9948	0.9999	1.0000 (86)
Living	20.4258	20.5235	20.6716	20.8656	20.9825	20.9995	21.0000	21.0000	20.9923	20.8205	20.5802	20.4032
Non living	19.2740	19.3993	19.5886	19.8237	19.9268	19.9344	19.9345	19.9345	19.9325	19.7762	19.4720	19.2449
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.7063	20.5235	20.6716	20.8656	20.9825	20.9995	21.0000	21.0000	20.9923	20.8205	20.5802	20.4866 (87)
Th 2	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345 (88)
util rest of house	1.0000	0.9998	0.9975	0.9584	0.7608	0.5018	0.3279	0.3759	0.6834	0.9866	0.9998	1.0000 (89)
MIT 2	19.6712	19.3993	19.5886	19.8237	19.9268	19.9344	19.9345	19.9345	19.9325	19.7762	19.4720	19.3692 (90)
Living area fraction	FLA = Living area / (4) =											
MIT	19.7958	19.5347	19.7190	19.9492	20.0540	20.0627	20.0628	20.0628	20.0602	19.9019	19.6055	19.5037 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.7958	19.5347	19.7190	19.9492	20.0540	20.0627	20.0628	20.0628	20.0602	19.9019	19.6055	19.5037 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	1.0000	0.9997	0.9971	0.9587	0.7706	0.5139	0.3405	0.3895	0.6974	0.9862	0.9997	1.0000 (94)
Useful gains	702.4222	828.5087	942.5793	1040.3429	902.2753	598.6107	379.5678	401.4848	649.5687	780.4742	698.7177	668.8670 (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	1698.5452	1604.1558	1448.9770	1211.1366	915.7033	598.7809	379.5692	401.4912	653.3110	1019.6146	1370.7660	1677.4910 (97)
Space heating kWh	741.1155	521.2349	376.7599	122.9715	9.9904	0.0000	0.0000	0.0000	0.0000	177.9205	483.8748	750.4162 (98a)
Space heating requirement - total per year (kWh/year)	3184.2837											
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	741.1155	521.2349	376.7599	122.9715	9.9904	0.0000	0.0000	0.0000	0.0000	177.9205	483.8748	750.4162 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	3184.2837											
Space heating per m2	(98c) / (4) = 34.3356 (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 %)	242.2829 (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	741.1155	521.2349	376.7599	122.9715	9.9904	0.0000	0.0000	0.0000	0.0000	177.9205	483.8748	750.4162 (98)
Space heating efficiency (main heating system 1)	242.2829	242.2829	242.2829	242.2829	242.2829	0.0000	0.0000	0.0000	0.0000	242.2829	242.2829	242.2829 (210)
Space heating fuel (main heating system)	305.8885	215.1348	155.5041	50.7553	4.1235	0.0000	0.0000	0.0000	0.0000	73.4350	199.7148	309.7273 (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	266.1329	235.1941	249.3374	217.8443	210.2633	188.4669	185.2204	193.0932	195.7970	219.5382	234.9358	263.0348 (64)
Efficiency of water heater (217)m	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228 (216)
Fuel for water heating, kWh/month	100.0038	88.3780	93.6926	81.8586	79.0099	70.8195	69.5996	72.5579	73.5739	82.4951	88.2810	98.8396 (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	3.8398	3.4682	3.8398	3.7160	3.8398	3.7160	3.8398	3.8398	3.7160	3.8398	3.7160	3.8398 (231)
Lighting	25.3053	20.3008	18.2787	13.3917	10.3442	8.4513	9.4363	12.2656	15.9319	20.9035	23.6104	26.0086 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-66.0360	-100.1905	-150.7777	-159.5261	-157.8037	-144.3935	-141.9997	-136.2253	-121.9621	-108.7552	-73.3261	-55.6795 (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	-28.9837	-73.3213	-181.1518	-332.7490	-487.5617	-504.3769	-492.2368	-393.8522	-259.3595	-123.2739	-42.4093	-21.7489 (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												1314.2834 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												266.1228

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Water heating fuel used	999.1094 (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)	45.2109 (230a)
Total electricity for the above, kWh/year	45.2109 (231)
Electricity for lighting (calculated in Appendix L)	204.2282 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-4357.7003 (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	-1794.8683 (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	1314.2834	0.1571	206.5055 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	999.1094	0.1410	140.8982 (264)
Space and water heating			347.4037 (265)
Pumps, fans and electric keep-hot	45.2109	0.1387	6.2713 (267)
Energy for lighting	204.2282	0.1443	29.4764 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1416.6754	0.1353	-191.6702
PV Unit electricity exported	-2941.0249	0.1216	-357.4905
Total			-549.1607 (269)
Total CO2, kg/year			-166.0093 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-1.7900 (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	1314.2834	1.5817	2078.7655 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	999.1094	1.5215	1520.1059 (278)
Space and water heating			3598.8713 (279)
Pumps, fans and electric keep-hot	45.2109	1.5128	68.3951 (281)
Energy for lighting	204.2282	1.5338	313.2520 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1416.6754	1.5001	-2125.1614
PV Unit electricity exported	-2941.0249	0.4460	-1311.6863
Total			-3436.8477 (283)
Total Primary energy kWh/year			543.6708 (286)
Dwelling Primary energy Rate (DPER)			5.8600 (287)

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

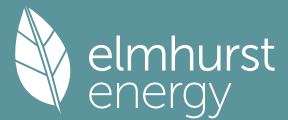
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	46.3700 (1b)	x 2.4000 (2b)	= 111.2880 (1b) - (3b)
First floor	46.3700 (1c)	x 2.7000 (2c)	= 125.1990 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.4870 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1269 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3769 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)

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Infiltration rate adjusted to include shelter factor

(21) = (18) x (20) = 0.3203 (21)

Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.4084	0.4004	0.3924	0.3524	0.3444	0.3043	0.3043	0.2963	0.3203	0.3444	0.3604	0.3764 (22b)
Effective ac	0.5834	0.5802	0.5770	0.5621	0.5593	0.5463	0.5463	0.5439	0.5513	0.5593	0.5649	0.5708 (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
Main dwelling							
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Opening Type			21.0300	1.1450	24.0802		(27)
GF			46.3700	0.1300	6.0281		(28a)
Main	147.7980	23.1800	124.6180	0.1800	22.4312		(29a)
Flat	46.3700		46.3700	0.1100	5.1007		(30)
Total net area of external elements Aum(A, m2)			240.5380				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 59.7902		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							650.0944 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	13.7400	0.0500	0.6870
E3 Sill	13.7400	0.0500	0.6870
E4 Jamb	40.7000	0.0500	2.0350
E5 Ground floor (normal)	28.9800	0.1600	4.6368
E6 Intermediate floor within a dwelling	28.9800	0.0000	0.0000
E16 Corner (normal)	30.6000	0.0900	2.7540
E17 Corner (inverted - internal area greater than external area)	10.2000	-0.0900	-0.9180
E10 Eaves (insulation at ceiling level)	15.0600	0.0600	0.9036
E12 Gable (insulation at ceiling level)	11.2200	0.0600	0.6732
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			11.4586 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 71.2488 (37)

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

(38)m	Jan 45.5292	Feb 45.2764	Mar 45.0287	Apr 43.8651	May 43.6473	Jun 42.6339	Jul 42.6339	Aug 42.4462	Sep 43.0242	Oct 43.6473	Nov 44.0878	Dec 44.5482 (38)
Heat transfer coeff	116.7780	116.5252	116.2775	115.1139	114.8961	113.8827	113.8827	113.6950	114.2730	114.8961	115.3366	115.7970 (39)
Average = Sum(39)m / 12 =												115.1128

HLP	Jan 1.2592	Feb 1.2565	Mar 1.2538	Apr 1.2413	May 1.2389	Jun 1.2280	Jul 1.2280	Aug 1.2260	Sep 1.2322	Oct 1.2389	Nov 1.2437	Dec 1.2486 (40)
HLP (average)												1.2412
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

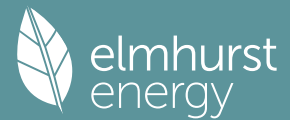
4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6614 (42)
Hot water usage for mixer showers												68.5789 (42a)
68.8427	67.8081	66.3005	63.4160	61.2874	58.9135	57.5642	59.0604	60.7004	63.2493	66.1957		
Hot water usage for baths												29.6273 (42b)
29.7278	29.2863	28.6646	27.5182	26.6599	25.7081	25.1940	25.8113	26.4835	27.5020	28.6720		
Hot water usage for other uses												41.8854 (42c)
41.8854	40.3623	38.8392	37.3161	35.7930	34.2699	34.2699	35.7930	37.3161	38.8392	40.3623		
Average daily hot water use (litres/day)												129.1106 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	140.4558	137.4567	133.8043	128.2503	123.7402	118.8914	117.0280	120.6647	124.5000	129.5904	135.2299	140.0916 (44)
Energy conte	222.4477	195.7365	205.6522	175.5683	166.5781	146.1909	141.5352	149.4080	153.5210	175.8530	192.6598	219.3496 (45)
Energy content (annual)												Total = Sum(45)m = 2144.5003
Distribution loss (46)m = 0.15 x (45)m												32.9024 (46)
33.3672	29.3605	30.8478	26.3352	24.9867	21.9286	21.2303	22.4112	23.0282	26.3779	28.8990		
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss												
27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	27.6637	26.7713	27.6637	27.6637	27.6637 (56)
If cylinder contains dedicated solar storage												
27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	27.6637	26.7713	27.6637	27.6637	27.6637 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
273.3738	241.7342	256.5782	224.8516	217.5042	195.4742	192.4613	200.3341	202.8043	226.7790	241.9431	270.2756 (62)	
WWHRS	-31.4720	-27.8341	-29.1462	-24.1342	-22.4923	-19.2468	-18.0408	-19.1846	-19.9135	-23.4758	-26.5952	-30.8892 (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	241.9018	213.9001	227.4320	200.7174	195.0119	176.2274	174.4205	181.1496	182.8908	203.3033	215.3479	239.3865 (64)
12Total per year (kWh/year)												2451.6892 (64)
Electric shower(s)												2452 (64)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month												
114.7047	101.8806	109.1202	97.8031	96.1281	88.0351	87.8013	90.4190	90.4724	99.2120	103.4860	113.6746 (65)	

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

Metabolic gains (Table 5), Watts												
(66)m	Jan 133.0699	Feb 133.0699	Mar 133.0699	Apr 133.0699	May 133.0699	Jun 133.0699	Jul 133.0699	Aug 133.0699	Sep 133.0699	Oct 133.0699	Nov 133.0699	Dec 133.0699 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												

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123.0603	136.2453	123.0603	127.1623	123.0603	127.1623	123.0603	123.0603	127.1623	123.0603	127.1623	123.0603 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5											
244.0293	246.5615	240.1803	226.5955	209.4470	193.3299	182.5627	180.0305	186.4117	199.9965	217.1449	233.2621 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5											
36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)											
-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559 (71)
Water heating gains (Table 5)											
154.1730	151.6080	146.6669	135.8376	129.2044	122.2710	118.0125	121.5310	125.6561	133.3494	143.7306	152.7884 (72)
Total internal gains	587.1835	600.3358	575.8285	555.5164	527.6327	505.6842	486.5565	487.5426	502.1510	522.3272	553.9588 (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					0.8800	10.6334	0.6300	0.7000	0.7700			2.8597 (74)
East					5.7900	19.6403	0.6300	0.7000	0.7700			34.7534 (76)
South					1.7400	46.7521	0.6300	0.7000	0.7700			24.8612 (78)
West					12.6200	19.6403	0.6300	0.7000	0.7700			75.7493 (80)

Solar gains	138.2236	262.3481	417.1476	592.7343	717.4761	731.6606	697.6454	604.3911	479.3827	306.9218	170.7807	114.7384 (83)
Total gains	725.4072	862.6839	992.9761	1148.2506	1245.1088	1237.3447	1184.2019	1091.9338	981.5337	829.2490	724.7395	689.7701 (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	143.4102	143.7213	144.0275	145.4834	145.7591	147.0562	147.0562	147.2990	146.5538	145.7591	145.2025	144.6251
alpha	10.5607	10.5814	10.6018	10.6989	10.7173	10.8037	10.8037	10.8199	10.7703	10.7173	10.6802	10.6417
util living area	1.0000	0.9999	0.9985	0.9752	0.8298	0.5882	0.4231	0.4789	0.7872	0.9938	0.9999	1.0000 (86)
MIT	20.3804	20.4872	20.6485	20.8616	20.9821	20.9995	21.0000	21.0000	20.9920	20.8121	20.5551	20.3643 (87)
Th 2	19.8729	19.8751	19.8772	19.8871	19.8890	19.8977	19.8977	19.8993	19.8943	19.8890	19.8852	19.8813 (88)
util rest of house	1.0000	0.9997	0.9969	0.9516	0.7461	0.4875	0.3171	0.3644	0.6714	0.9843	0.9997	1.0000 (89)
MIT 2	19.1633	19.3021	19.5099	19.7753	19.8813	19.8976	19.8977	19.8993	19.8923	19.7258	19.3978	19.1497 (90)
Living area fraction									fLA = Living area / (4) =			0.1204 (91)
MIT	19.3099	19.4448	19.6471	19.9061	20.0139	20.0303	20.0304	20.0319	20.0247	19.8566	19.5372	19.2960 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3099	19.4448	19.6471	19.9061	20.0139	20.0303	20.0304	20.0319	20.0247	19.8566	19.5372	19.2960 (93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9996	0.9964	0.9522	0.7563	0.4997	0.3299	0.3782	0.6858	0.9838	0.9997	1.0000 (94)
Useful gains	725.3690	862.3498	989.3633	1093.3223	941.6341	618.2464	390.6670	412.9171	673.1422	815.8325	724.4952	689.7491 (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	1752.8299	1694.8414	1528.7068	1266.9588	955.2324	618.4187	390.6686	412.9240	677.0385	1063.5489	1434.4595	1748.0751 (97)
Space heating kWh	764.4309	559.4344	401.2716	125.0183	10.1171	0.0000	0.0000	0.0000	0.0000	184.3011	511.1743	787.3945 (98a)
Space heating requirement - total per year (kWh/year)												3343.1422
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	764.4309	559.4344	401.2716	125.0183	10.1171	0.0000	0.0000	0.0000	0.0000	184.3011	511.1743	787.3945 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3343.1422
Space heating per m2											(98c) / (4) =	36.0485 (99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	764.4309	559.4344	401.2716	125.0183	10.1171	0.0000	0.0000	0.0000	0.0000	184.3011	511.1743	787.3945 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	828.2025	606.1044	434.7471	135.4478	10.9612	0.0000	0.0000	0.0000	0.0000	199.6761	553.8183	853.0818 (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	241.9018	213.9001	227.4320	200.7174	195.0119	176.2274	174.4205	181.1496	182.8908	203.3033	215.3479	239.3865 (64)
Efficiency of water heater (217)m	86.4561	86.1137	85.3191	83.0298	80.2009	79.8000	79.8000	79.8000	79.8000	83.8404	85.9275	79.8000 (216)
Fuel for water heating, kWh/month	279.7972	248.3927	266.5663	241.7414	243.1543	220.8364	218.5721	227.0045	229.1865	242.4885	250.6159	276.6677 (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)

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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	25.5695	20.5128	18.4695	13.5315	10.4522	8.5395	9.5348	12.3937	16.0982	21.1217	23.8569	26.2801	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-42.7012	-59.8576	-85.5553	-95.6298	-102.6299	-95.5926	-94.3699	-89.2970	-80.3163	-68.1318	-46.8060	-36.9546	(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	-25.1936	-52.8700	-104.8580	-157.1808	-207.5550	-208.4709	-206.0562	-174.6309	-128.1903	-75.5538	-33.6161	-19.9358	(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												3622.0392	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												2945.0234	(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)												206.3605	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2291.9534	(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												4567.4697	(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	3622.0392	0.2100	760.6282	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2945.0234	0.2100	618.4549	(264)
Space and water heating			1379.0831	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	206.3605	0.1443	29.7842	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-897.8420	0.1347	-120.9529	
PV Unit electricity exported	-1394.1114	0.1259	-175.5882	
Total			-296.5412	(269)
Total CO2, kg/year			1124.2554	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.1200	(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	3622.0392	1.1300	4092.9043	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2945.0234	1.1300	3327.8765	(278)
Space and water heating			7420.7808	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	206.3605	1.5338	316.5226	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-897.8420	1.4979	-1344.8702	
PV Unit electricity exported	-1394.1114	0.4623	-644.5326	
Total			-1989.4028	(283)
Total Primary energy kWh/year			5878.0013	(286)
Target Primary Energy Rate (TPER)			63.3800	(287)

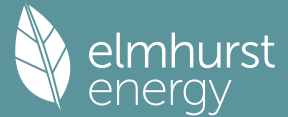
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Main dwelling				
Ground floor	46.3700 (1b)	x 2.4000 (2b)	= 111.2880 (1b) - (3b)	
First floor	46.3700 (1c)	x 2.7000 (2c)	= 125.1990 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7400		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.4870 (5)	

2. Ventilation rate

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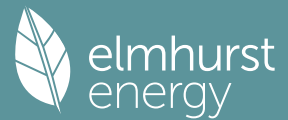
												m3 per hour
Number of open chimneys												0 * 80 = 0.0000 (6a)
Number of open flues												0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire												0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler												0 * 20 = 0.0000 (6d)
Number of flues attached 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) = 0.1269 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												4.0000 (17)
Infiltration rate												0.3269 (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) = 0.2778 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
	0.3542	0.3473	0.3403	0.3056	0.2987	0.2639	0.2639	0.2570	0.2778	0.2987	0.3126	0.3264 (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	0.5627	0.5603	0.5579	0.5467	0.5446	0.5348	0.5348	0.5330	0.5386	0.5446	0.5488	0.5533 (25)

3. Heat losses and heat loss parameter												

Element			Gross	Openings	NetArea	U-value	A x U		K-value	A x K		
			m2	m2	m2	W/m2K	W/K		kJ/m2K	kJ/K		
Main dwelling												
Door					2.1500	1.0000	2.1500			(26)		
Window					23.0600	1.1450	26.4046			(27)		
GF					46.3700	0.1100	5.1007		75.0000	3477.7500 (28a)		
Main			147.7980	25.2100	122.5880	0.1800	22.0658		110.0000	13484.6800 (29a)		
Flat			46.3700		46.3700	0.1000	4.6370		9.0000	417.3300 (30)		
Total net area of external elements Aum(A, m2)					240.5380					(31)		
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =		60.3581		(33)			
Main dwelling												
Internal Wall 1					555.4400				75.0000	41658.0002 (32c)		
Internal Floor 1					46.3700				18.0000	834.6600 (32d)		
Internal Ceiling 1					46.3700				9.0000	417.3300 (32e)		
Heat capacity Cm = Sum(A x k)												(28)...(30) + (32) + (32a)...(32e) = 60289.7502 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K												650.0944 (35)
List of Thermal Bridges												
K1 Element						Length	Psi-value	Total				
E2 Other lintels (including other steel lintels)						13.7400	0.0500	0.6870				
E3 Sill						13.7400	0.0500	0.6870				
E4 Jamb						40.7000	0.0500	2.0350				
E5 Ground floor (normal)						28.9800	0.1600	4.6368				
E6 Intermediate floor within a dwelling						28.9800	0.0000	0.0000				
E16 Corner (normal)						30.6000	0.0500	1.5300				
E17 Corner (inverted - internal area greater than external area)						10.2000	-0.0900	-0.9180				
E10 Eaves (insulation at ceiling level)						15.0600	0.0600	0.9036				
E12 Gable (insulation at ceiling level)						11.2200	0.0600	0.6732				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												10.2346 (36)
Point Thermal bridges												(36a) = 0.0000
Total fabric heat loss												(33) + (36) + (36a) = 70.5927 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	43.9166	43.7265	43.5401	42.6648	42.5010	41.7386	41.7386	41.5974	42.0323	42.5010	42.8323	43.1787 (38)
Average = Sum(39)m / 12 =	114.5093	114.3192	114.1328	113.2575	113.0937	112.3313	112.3313	112.1902	112.6250	113.0937	113.4250	113.7714 (39)
												113.2567
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2347	1.2327	1.2307	1.2212	1.2195	1.2113	1.2113	1.2097	1.2144	1.2195	1.2230	1.2268 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												2.6614 (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	29.7278	29.2863	28.6646	27.5182	26.6599	25.7081	25.1940	25.8113	26.4835	27.5020	28.6720	29.6273 (42b)
Hot water usage for other uses	41.8854	40.3623	38.8392	37.3161	35.7930	34.2699	34.2699	35.7930	37.3161	38.8392	40.3623	41.8854 (42c)
Average daily hot water use (litres/day)												65.6400 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	71.6132	69.6486	67.5038	64.8343	62.4528	59.9779	59.4638	61.6043	63.7996	66.3412	69.0342	71.5127 (44)
Energy content (annual)	113.4178	99.1787	103.7508	88.7549	84.0735	73.7499	71.9163	76.2790	78.6713	90.0243	98.3519	111.9716 (45)
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												

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WHRHS	96.4051	84.3019	88.1881	75.4417	71.4625	62.6874	61.1289	64.8371	66.8706	76.5207	83.5991	95.1759 (62)
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 (63a)
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 (63b)
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 (63c)
Output from w/h	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)
12Total per year (kWh/year)	96.4051	84.3019	88.1881	75.4417	71.4625	62.6874	61.1289	64.8371	66.8706	76.5207	83.5991	95.1759 (64)
Electric shower(s)												926.6190 (64)
	55.1315	49.1226	53.6400	51.1880	52.1485	49.7446	51.4028	52.1485	51.1880	53.6400	52.6314	55.1315 (64a)
Heat gains from water heating, kWh/month	37.8842	33.3561	35.4570	31.6574	30.9028	28.1080	28.1329	29.2464	29.5147	32.5402	34.0576	37.5768 (65)
												927 (64)
												627.1175 (64a)

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	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	133.0699	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	123.0847	136.2724	123.0847	127.1876	123.0847	127.1876	123.0847	123.0847	127.1876	123.0847	127.1876	123.0847	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.0293	246.5615	240.1803	226.5955	209.4470	193.3299	182.5627	180.0305	186.4117	199.9965	217.1449	233.2621	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	(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)	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	(71)
Water heating gains (Table 5)	50.9196	49.6371	47.6573	43.9686	41.5360	39.0389	37.8131	39.3097	40.9926	43.7368	47.3023	50.5065	(72)
Total internal gains	480.9545	495.3920	473.8433	460.6727	436.9887	422.4774	406.3815	405.3459	417.5128	429.7390	454.5557	469.7743	(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				0.9700	10.6334	0.3300	0.0000	0.7700	2.6209 (74)			
East				6.3500	19.6403	0.3300	0.0000	0.7700	31.6903 (76)			
South				1.9100	46.7521	0.3300	0.0000	0.7700	22.6902 (78)			
West				13.8300	19.6403	0.3300	0.0000	0.7700	69.0199 (80)			
Solar gains	126.0212	239.1798	380.2951	540.3590	654.0760	667.0077	635.9979	550.9844	437.0276	279.8129	155.7025	104.6105 (83)
Total gains	606.9758	734.5717	854.1385	1001.0316	1091.0647	1089.4850	1042.3794	956.3302	854.5404	709.5519	610.2583	574.3847 (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	146.2514	146.4947	146.7339	147.8679	148.0821	149.0871	149.0871	149.2747	148.6984	148.0821	147.6495	147.2000	
alpha	10.7501	10.7663	10.7823	10.8579	10.8721	10.9391	10.9391	10.9516	10.9132	10.8721	10.8433	10.8133	
util living area	1.0000	1.0000	0.9996	0.9909	0.8980	0.6575	0.4741	0.5394	0.8663	0.9984	1.0000	1.0000	(86)
MIT	20.3384	20.4394	20.5938	20.8079	20.9635	20.9987	21.0000	20.9999	20.9813	20.7626	20.5098	20.3219	(87)
Th 2	19.8923	19.8939	19.8955	19.9030	19.9045	19.9110	19.9110	19.9122	19.9085	19.9045	19.9016	19.8986	(88)
util rest of house	1.0000	0.9999	0.9992	0.9803	0.8248	0.5473	0.3568	0.4120	0.7554	0.9955	1.0000	1.0000	(89)
MIT 2	19.2950	19.3974	19.5531	19.7687	19.8903	19.9108	19.9110	19.9122	19.9041	19.7289	19.4746	19.2841	(90)
Living area fraction	19.4207	19.5229	19.6784	19.8938	20.0195	20.0418	20.0422	20.0432	20.0338	19.8534	19.5992	19.4091	(91)
MIT	19.4207	19.5229	19.6784	19.8938	20.0195	20.0418	20.0422	20.0432	20.0338	19.8534	19.5992	19.4091	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4207	19.5229	19.6784	19.8938	20.0195	20.0418	20.0422	20.0432	20.0338	19.8534	19.5992	19.4091	(93)

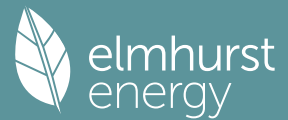
8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	1.0000	0.9999	0.9990	0.9802	0.8337	0.5606	0.3709	0.4274	0.7697	0.9952	0.9999	1.0000	(94)
Ext temp.	606.9708	734.5129	853.3106	981.1809	909.6100	610.8073	386.6585	408.7121	657.7763	706.1759	610.2210	574.3822	(95)
Heat loss rate W	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)
Space heating kWh	1731.4591	1671.6759	1504.0929	1245.1343	940.8882	611.2900	386.6632	408.7333	668.2973	1046.5029	1417.7271	1730.3637	(97)
Space heating requirement - total per year (kWh/year)	836.6194	629.7735	484.1821	190.0464	23.2710	0.0000	0.0000	0.0000	0.0000	253.2032	581.4044	860.0503	(98a)
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)	836.6194	629.7735	484.1821	190.0464	23.2710	0.0000	0.0000	0.0000	0.0000	253.2032	581.4044	860.0503	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3858.5502	(99)
Space heating per m ²												41.6061	(100)

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	1055.9146	831.2519	852.6452	0.0000	0.0000	0.0000	0.0000	(100)

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Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9672	0.9931	0.9824	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1021.3085	825.5253	837.6644	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1224.8376	1172.1634	1074.0032	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	146.5409	257.8987	175.8361	0.0000	0.0000	0.0000	0.0000	(104)
Intermittency factor (Table 10b)									fc = cooled area / (4) =				1.0000 (105)
Space cooling kWh	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 requirement	0.0000	0.0000	0.0000	0.0000	0.0000	36.6352	64.4747	43.9590	0.0000	0.0000	0.0000	0.0000	(107)
Energy for space heating												145.0689	(107)
Energy for space cooling												41.6061	(99)
Total												1.5643	(108)
Fabric Energy Efficiency (DFEE)												43.1704	(109)
												43.2	(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 (m ²)	Storey height (m)	Volume (m ³)	
Main dwelling				
Ground floor	46.3700 (1b)	x 2.4000 (2b)	= 111.2880 (1b) - (3b)	
First floor	46.3700 (1c)	x 2.7000 (2c)	= 125.1990 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7400		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	236.4870 (5)	

2. Ventilation rate

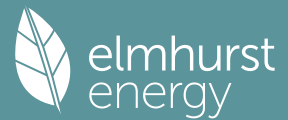
	m ³ per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour	30.0000 / (5) = 0.1269 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3769	(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 infiltr rate	0.4084	0.4004	0.3924	0.3524	0.3444	0.3043	0.3043	0.2963	0.3203	0.3444	0.3604	0.3764	(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	0.5802	0.5770	0.5621	0.5593	0.5463	0.5463	0.5439	0.5513	0.5593	0.5649	0.5708	(25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K	
Main dwelling								
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type			21.0300	1.1450	24.0802			(27)
GF			46.3700	0.1300	6.0281			(28a)
Main	147.7980	23.1800	124.6180	0.1800	22.4312			(29a)
Flat	46.3700		46.3700	0.1100	5.1007			(30)
Total net area of external elements Aum(A, m ²)			240.5380					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.7902			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							650.0944	(35)
List of Thermal Bridges								
K1 Element				Length	Psi-value	Total		
E2 Other lintels (including other steel lintels)				13.7400	0.0500	0.6870		
E3 Sill				13.7400	0.0500	0.6870		
E4 Jamb				40.7000	0.0500	2.0350		
E5 Ground floor (normal)				28.9800	0.1600	4.6368		
E6 Intermediate floor within a dwelling				28.9800	0.0900	0.0000		
E16 Corner (normal)				30.6000	0.0900	2.7540		
E17 Corner (inverted - internal area greater than external area)				10.2000	-0.0900	-0.9180		
E10 Eaves (insulation at ceiling level)				15.0600	0.0600	0.9036		
E12 Gable (insulation at ceiling level)				11.2200	0.0600	0.6732		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.4586	(36)
Point Thermal bridges						(36a) =	0.0000	
Total fabric heat loss						(33) + (36) + (36a) =	71.2488	(37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)								

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(38)m	Jan 45.5292	Feb 45.2764	Mar 45.0287	Apr 43.8651	May 43.6473	Jun 42.6339	Jul 42.6339	Aug 42.4462	Sep 43.0242	Oct 43.6473	Nov 44.0878	Dec 44.5482	(38)
Heat transfer coeff	116.7780	116.5252	116.2775	115.1139	114.8961	113.8827	113.8827	113.6950	114.2730	114.8961	115.3366	115.7970	(39)
Average = Sum(39)m / 12 =												115.1128	
HLP	Jan 1.2592	Feb 1.2565	Mar 1.2538	Apr 1.2413	May 1.2389	Jun 1.2280	Jul 1.2280	Aug 1.2260	Sep 1.2322	Oct 1.2389	Nov 1.2437	Dec 1.2486	(40)
HLP (average)												1.2412	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.6614	(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	0.0000	(42a)
Hot water usage for baths	29.7278	29.2863	28.6646	27.5182	26.6599	25.7081	25.1940	25.8113	26.4835	27.5020	28.6720	29.6273	29.6273	(42b)
Hot water usage for other uses	41.8854	40.3623	38.8392	37.3161	35.7930	34.2699	34.2699	35.7930	37.3161	38.8392	40.3623	41.8854	41.8854	(42c)
Average daily hot water use (litres/day)												65.6400	65.6400	(43)
Daily hot water use	Jan 71.6132	Feb 69.6486	Mar 67.5038	Apr 64.8343	May 62.4528	Jun 59.9779	Jul 59.4638	Aug 61.6043	Sep 63.7996	Oct 66.3412	Nov 69.0342	Dec 71.5127	71.5127	(44)
Energy conte	113.4178	99.1787	103.7508	88.7549	84.0735	73.7499	71.9163	76.2790	78.6713	90.0243	98.3519	111.9716	111.9716	(45)
Energy content (annual)										Total = Sum(45)m =		1090.1400	1090.1400	
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	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	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	0.0000	(61)
Total heat required for water heating calculated for each month	96.4051	84.3019	88.1881	75.4417	71.4625	62.6874	61.1289	64.8371	66.8706	76.5207	83.5991	95.1759	95.1759	(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	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	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	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	0.0000	(63d)
Output from w/h	96.4051	84.3019	88.1881	75.4417	71.4625	62.6874	61.1289	64.8371	66.8706	76.5207	83.5991	95.1759	95.1759	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		926.6190	926.6190	(64)
Electric shower(s)	55.1315	49.1226	53.6400	51.1880	52.1485	49.7446	51.4028	52.1485	51.1880	53.6400	52.6314	55.1315	55.1315	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		627.1175	627.1175	(64a)
Heat gains from water heating, kWh/month	37.8842	33.3561	35.4570	31.6574	30.9028	28.1080	28.1329	29.2464	29.5147	32.5402	34.0576	37.5768	37.5768	(65)

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

Metabolic gains (Table 5), Watts														
(66)m	Jan 133.0699	Feb 133.0699	Mar 133.0699	Apr 133.0699	May 133.0699	Jun 133.0699	Jul 133.0699	Aug 133.0699	Sep 133.0699	Oct 133.0699	Nov 133.0699	Dec 133.0699	133.0699	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	123.0603	136.2453	123.0603	127.1623	123.0603	127.1623	123.0603	123.0603	127.1623	123.0603	127.1623	123.0603	123.0603	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	244.0293	246.5615	240.1803	226.5955	209.4470	193.3299	182.5627	180.0305	186.4117	199.9965	217.1449	233.2621	233.2621	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	36.3070	(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	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	(71)
Water heating gains (Table 5)	50.9196	49.6371	47.6573	43.9686	41.5360	39.0389	37.8131	39.3097	40.9926	43.7368	47.3023	50.5065	50.5065	(72)
Total internal gains	480.9301	495.3649	473.8189	460.6474	436.9642	422.4521	406.3570	405.3214	417.4875	429.7145	454.5305	469.7498	469.7498	(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				0.8800	10.6334		0.6300		0.7000		0.7700		2.8597 (74)
East				5.7900	19.6403		0.6300		0.7000		0.7700		34.7534 (76)
South				1.7400	46.7521		0.6300		0.7000		0.7700		24.8612 (78)
West				12.6200	19.6403		0.6300		0.7000		0.7700		75.7493 (80)
Solar gains	138.2236	262.3481	417.1476	592.7343	717.4761	731.6606	697.6454	604.3911	479.3827	306.9218	170.7807	114.7384	(83)
Total gains	619.1537	757.7129	890.9665	1053.3816	1154.4403	1154.1126	1104.0024	1009.7125	896.8702	736.6364	625.3112	584.4882	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains from living area, nil,m (see Table 9a)														
tau	Jan 143.4102	Feb 143.7213	Mar 144.0275	Apr 145.4834	May 145.7591	Jun 147.0562	Jul 147.0562	Aug 147.2990	Sep 146.5538	Oct 145.7591	Nov 145.2025	Dec 144.6251	144.6251	
alpha	10.5607	10.5814	10.6018	10.6989	10.7173	10.8037	10.8037	10.8199	10.7703	10.7173	10.6802	10.6417	10.6417	
util living area	1.0000	1.0000	0.9995	0.9872	0.8751	0.6299	0.4538	0.5178	0.8451	0.9978	1.0000	1.0000	1.0000	(86)
MIT	20.3267	20.4341	20.5974	20.8212	20.9705	20.9990	21.0000	20.9999	20.9845	20.7670	20.5047	20.3110	20.3110	(87)
Th 2	19.8729	19.8751	19.8772	19.8871	19.8890	19.8977	19.8977	19.8993	19.8943	19.8890	19.8852	19.8813	19.8813	(88)

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util rest of house	1.0000	0.9999	0.9988	0.9732	0.7965	0.5225	0.3402	0.3940	0.7307	0.9941	0.9999	1.0000 (89)
MIT 2	19.2662	19.3755	19.5404	19.7658	19.8782	19.8976	19.8977	19.8993	19.8909	19.7193	19.4551	19.2579 (90)
Living area fraction									FLA = Living area /	(4) =		0.1204 (91)
MIT	19.3939	19.5030	19.6677	19.8929	20.0097	20.0302	20.0304	20.0318	20.0226	19.8455	19.5815	19.3847 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3939	19.5030	19.6677	19.8929	20.0097	20.0302	20.0304	20.0318	20.0226	19.8455	19.5815	19.3847 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	1.0000	0.9999	0.9987	0.9733	0.8061	0.5355	0.3539	0.4089	0.7454	0.9939	0.9999	1.0000	(94)
Useful gains	619.1473	757.6325	889.7670	1025.2875	930.5698	618.0684	390.6650	412.9077	668.4877	732.1084	625.2632	584.4851	(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	1762.6392	1701.6232	1531.1076	1265.4340	954.7560	618.4078	390.6684	412.9231	676.7955	1062.2687	1439.5727	1758.3470	(97)
Space heating kWh	850.7580	634.3618	477.1574	172.9055	17.9945	0.0000	0.0000	0.0000	0.0000	245.6392	586.3028	873.3533	(98a)
Space heating requirement - total per year (kWh/year)												3858.4725	
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	850.7580	634.3618	477.1574	172.9055	17.9945	0.0000	0.0000	0.0000	0.0000	245.6392	586.3028	873.3533	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3858.4725	
Space heating per m2											(98c) / (4) =	41.6053	(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	1070.4970	842.7317	864.0818	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9760	0.9952	0.9871	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1044.7767	838.6505	852.9621	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1300.4037	1244.2166	1136.4237	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	184.0515	301.7412	210.8954	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	46.0129	75.4353	52.7239	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												174.1720 (107)
Energy for space heating												41.6053 (99)
Energy for space cooling												1.8781 (108)
Total												43.4833 (109)
Fabric Energy Efficiency (TFEE)												43.5 (109)

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

1. Overall dwelling characteristics

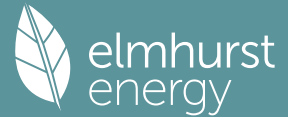
	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	46.3700 (1b)	x 2.4000 (2b)	= 111.2880 (1b) - (3b)
First floor	46.3700 (1c)	x 2.7000 (2c)	= 125.1990 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	236.4870 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2000 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1700 (21)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998 (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	
Main dwelling								
Door			2.1500	1.0000	2.1500			(26)
Window			23.0600	1.1450	26.4046			(27)
GF			46.3700	0.1100	5.1007	75.0000	3477.7500	(28a)
Main	147.7980	25.2100	122.5880	0.1800	22.0658	110.0000	13484.6800	(29a)
Flat	46.3700		46.3700	0.1000	4.6370	9.0000	417.3300	(30)
Total net area of external elements Aum(A, m2)			240.5380					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	60.3581		(33)
Main dwelling								
Internal Wall 1			555.4400			75.0000	41658.0002	(32c)
Internal Floor 1			46.3700			18.0000	834.6600	(32d)
Internal Ceiling 1			46.3700			9.0000	417.3300	(32e)
Heat capacity Cm = Sum(A x k)								
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								(28)...(30) + (32) + (32a)...(32e) = 60289.7502 (34)
List of Thermal Bridges								650.0944 (35)
K1 Element				Length	Psi-value		Total	
E2 Other lintels (including other steel lintels)				13.7400	0.0500		0.6870	
E3 Sill				13.7400	0.0500		0.6870	
E4 Jamb				40.7000	0.0500		2.0350	
E5 Ground floor (normal)				28.9800	0.1600		4.6368	
E6 Intermediate floor within a dwelling				28.9800	0.0000		0.0000	
E16 Corner (normal)				30.6000	0.0500		1.5300	
E17 Corner (inverted - internal area greater than external area)				10.2000	-0.0900		-0.9180	
E10 Eaves (insulation at ceiling level)				15.0600	0.0600		0.9036	
E12 Gable (insulation at ceiling level)				11.2200	0.0600		0.6732	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2346	(36)
Point Thermal bridges							(36a) =	0.0000
Total fabric heat loss							(33) + (36) + (36a) =	70.5927 (37)

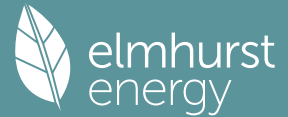
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	(38)
Average = Sum(39)m / 12 =	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	(39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.6614 (42)
Hot water usage for mixer showers													
Hot water usage for baths	68.8427	67.8081	66.3005	63.4160	61.2874	58.9135	57.5642	59.0604	60.7004	63.2493	66.1957	68.5789	(42a)
Hot water usage for other uses	29.7278	29.2863	28.6646	27.5182	26.6599	25.7081	25.1940	25.8113	26.4835	27.5020	28.6720	29.6273	(42b)
Average daily hot water use (litres/day)	41.8854	40.3623	38.8392	37.3161	35.7930	34.2699	34.2699	35.7930	37.3161	38.8392	40.3623	41.8854	(42c)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	140.4558	137.4567	133.8043	128.2503	123.7402	118.8914	117.0280	120.6647	124.5000	129.5904	135.2299	140.0916	(44)
Energy content (annual)	222.4477	195.7365	205.6522	175.5683	166.5781	146.1909	141.5352	149.4080	153.5210	175.8530	192.6598	219.3496	(45)
Distribution loss (46)m = 0.15 x (45)m	33.3672	29.3605	30.8478	26.3352	24.9867	21.9286	21.2303	22.4112	23.0282	26.3779	28.8990	32.9024	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2200 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.6588 (55)
Total storage loss	20.4228	18.4464	20.4228	19.7640	20.4228	19.7640	20.4228	20.4228	19.7640	20.4228	19.7640	20.4228	(56)
If cylinder contains dedicated solar storage													
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	(57)
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	(59)
Total heat required for water heating calculated for each month	266.1329	235.1941	249.3374	217.8443	210.2633	188.4669	185.2204	193.0932	195.7970	219.5382	234.9358	263.0348	(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	266.1329	235.1941	249.3374	217.8443	210.2633	188.4669	185.2204	193.0932	195.7970	219.5382	234.9358	263.0348	(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	108.9120	96.6485	103.3275	92.1973	90.3354	82.4293	82.0086	84.6263	84.8665	93.4193	97.8802	107.8819	(65)

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

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Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.9106	25.6782	20.8829	15.8097	11.8179	9.9772	10.7807	14.0132	18.8084	23.8816	27.8734	29.7141	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	364.2228	368.0023	358.4781	338.2022	312.6075	288.5521	272.4817	268.7022	278.2264	298.5023	324.0969	348.1523	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	(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)	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	(71)
Water heating gains (Table 5)	146.3871	143.8221	138.8811	128.0518	121.4185	114.4851	110.2266	113.7451	117.8702	125.5635	135.9447	145.0025	(72)
Total internal gains	646.3783	644.3603	625.0998	588.9214	552.7017	519.8722	500.3468	503.3181	521.7627	554.8052	594.7728	629.7267	(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					0.9700	10.6334	0.3300	0.0000			0.7700	2.6209 (74)				
East					6.3500	19.6403	0.3300	0.0000			0.7700	31.6903 (76)				
South					1.9100	46.7521	0.3300	0.0000			0.7700	22.6902 (78)				
West					13.8300	19.6403	0.3300	0.0000			0.7700	69.0199 (80)				

Solar gains					126.0212	239.1798	380.2951	540.3590	654.0760	667.0077	635.9979	550.9844	437.0276	279.8129	155.7025	104.6105 (83)
Total gains					772.3995	883.5401	1005.3949	1129.2804	1206.7777	1186.8798	1136.3446	1054.3025	958.7903	834.6181	750.4753	734.3372 (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	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	
alpha	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	
util living area	1.0000	0.9998	0.9978	0.9714	0.8220	0.5904	0.4244	0.4782	0.7764	0.9916	0.9998	1.0000	(86)
Living	20.4614	20.5514	20.7016	20.8833	20.9860	20.9996	21.0000	21.0000	20.9939	20.8410	20.6064	20.4365	
Non living	19.3196	19.4350	19.6264	19.8420	19.9285	19.9344	19.9345	19.9345	19.9330	19.8001	19.5056	19.2876	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.7245	20.5514	20.7016	20.8833	20.9860	20.9996	21.0000	21.0000	20.9939	20.8410	20.6064	20.5153	(87)
Th 2	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	(88)
util rest of house	0.9999	0.9996	0.9955	0.9457	0.7404	0.4926	0.3216	0.3675	0.6646	0.9794	0.9996	1.0000	(89)
MIT 2	19.6894	19.4350	19.6264	19.8420	19.9285	19.9344	19.9345	19.9345	19.9330	19.8001	19.5056	19.4042	(90)
Living area fraction									fLA = Living area / (4) =			0.1204	(91)
MIT	19.8140	19.5694	19.7559	19.9674	20.0559	20.0627	20.0628	20.0628	20.0608	19.9255	19.6382	19.5380	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8140	19.5694	19.7559	19.9674	20.0559	20.0627	20.0628	20.0628	20.0608	19.9255	19.6382	19.5380	(93)

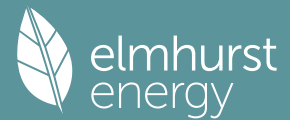
8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9999	0.9994	0.9949	0.9467	0.7503	0.5044	0.3340	0.3808	0.6785	0.9792	0.9995	0.9999	(94)
Useful gains	772.3377	883.0487	1000.3025	1069.1114	905.4557	598.6426	379.5681	401.4863	650.4969	817.2938	750.0831	734.2980	(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	1700.5407	1607.9606	1453.0201	1213.1341	915.9159	598.7834	379.5693	401.4914	653.3764	1022.1930	1374.3489	1681.2471	(97)
Space heating kWh	690.5831	487.1408	336.8218	103.6963	7.7824	0.0000	0.0000	0.0000	0.0000	152.4451	449.4714	704.5301	(98a)
Space heating requirement - total per year (kWh/year)												2932.4709	
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	690.5831	487.1408	336.8218	103.6963	7.7824	0.0000	0.0000	0.0000	0.0000	152.4451	449.4714	704.5301	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2932.4709	
Space heating per m2										(98c) / (4) =		31.6203	(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 %)													242.2829 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	690.5831	487.1408	336.8218	103.6963	7.7824	0.0000	0.0000	0.0000	0.0000	152.4451	449.4714	704.5301	(98)
Space heating efficiency (main heating system 1)	242.2829	242.2829	242.2829	242.2829	242.2829	0.0000	0.0000	0.0000	0.0000	242.2829	242.2829	242.2829	(210)
Space heating fuel (main heating system)	285.0317	201.0628	139.0201	42.7997	3.2121	0.0000	0.0000	0.0000	0.0000	62.9203	185.5151	290.7882	(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)

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Water heating												
Water heating requirement												
	266.1329	235.1941	249.3374	217.8443	210.2633	188.4669	185.2204	193.0932	195.7970	219.5382	234.9358	263.0348 (64)
Efficiency of water heater												266.1228 (216)
(217)m	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228 (217)
Fuel for water heating, kWh/month												
	100.0038	88.3780	93.6926	81.8586	79.0099	70.8195	69.5996	72.5579	73.5739	82.4951	88.2810	98.8396 (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	3.8398	3.4682	3.8398	3.7160	3.8398	3.7160	3.8398	3.8398	3.7160	3.8398	3.7160	3.8398 (231)
Lighting	25.3053	20.3008	18.2787	13.3917	10.3442	8.4513	9.4363	12.2656	15.9319	20.9035	23.6104	26.0086 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-65.6754	-99.5109	-148.9453	-157.7304	-157.5059	-144.3935	-141.9997	-136.2253	-121.9621	-107.6880	-72.8902	-55.4266 (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	-29.3443	-74.0009	-182.9843	-334.5447	-487.8595	-504.3769	-492.2368	-393.8522	-259.3595	-124.3412	-42.8452	-22.0017 (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												1210.3500 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												266.1228
Water heating fuel used												999.1094 (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)												45.2109 (230a)
Total electricity for the above, kWh/year												45.2109 (231)
Electricity for lighting (calculated in Appendix L)												204.2282 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-4357.7003 (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												-1898.8017 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1210.3500	16.4900	199.5867 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	999.1094	16.4900	164.7531 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	45.2109	16.4900	7.4553 (249)
Energy for lighting	204.2282	16.4900	33.6772 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1409.9533	16.4900	-232.5013
PV Unit electricity exported	-2947.7471	5.5900	-164.7791
Total			-397.2804 (252)
Total energy cost			8.1920 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.3600 (256)
Energy cost factor (ECF)			0.0214 (257)
SAP value			99.6529
SAP rating (Section 12)			100 (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	1210.3500	0.1573	190.4131 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	999.1094	0.1410	140.8982 (264)
Space and water heating			331.3112 (265)
Pumps, fans and electric keep-hot	45.2109	0.1387	6.2713 (267)
Energy for lighting	204.2282	0.1443	29.4764 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1409.9533	0.1352	-190.6740
PV Unit electricity exported	-2947.7471	0.1217	-358.5949
Total			-549.2689 (269)
Total CO2, kg/year			-182.2099 (272)
CO2 emissions per m2			-1.9600 (273)
EI value			101.7726
EI rating			102 (274)
EI band			A

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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

Main dwelling	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.3700 (1b)	x 2.4000 (2b)	= 111.2880 (1b) - (3b)
First floor	46.3700 (1c)	x 2.7000 (2c)	= 125.1990 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.4870 (5)

2. Ventilation rate

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

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	= 0.0000 / (5) = 0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		4.0000 (17)
Infiltration rate		0.2000 (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)	= 0.1700 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	5.2000	5.2000	4.7000	4.9000	4.2000	4.3000	4.3000	4.2000	4.7000	4.8000	5.4000 (22)
Wind factor	1.3250	1.3000	1.3000	1.1750	1.2250	1.0500	1.0750	1.0750	1.0500	1.1750	1.2000	1.3500 (22a)
Adj infilt rate	0.2253	0.2210	0.2210	0.1998	0.2083	0.1785	0.1827	0.1827	0.1785	0.1998	0.2040	0.2295 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												
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

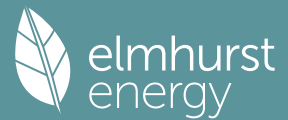
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Door			2.1500	1.0000	2.1500		(26)
Window			23.0600	1.1450	26.4046		(27)
GF			46.3700	0.1100	5.1007	75.0000	3477.7500 (28a)
Main	147.7980	25.2100	122.5880	0.1800	22.0658	110.0000	13484.6800 (29a)
Flat	46.3700		46.3700	0.1000	4.6370	9.0000	417.3300 (30)
Total net area of external elements Aum(A, m ²)			240.5380				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.3581		(33)
Main dwelling							
Internal Wall 1			555.4400			75.0000	41658.0002 (32c)
Internal Floor 1			46.3700			18.0000	834.6600 (32d)
Internal Ceiling 1			46.3700			9.0000	417.3300 (32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	60289.7502 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K		650.0944 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element	13.7400	0.0500	0.6870
E2 Other lintels (including other steel lintels)	13.7400	0.0500	0.6870
E3 Sill	40.7000	0.0500	2.0350
E4 Jamb	28.9800	0.1600	4.6368
E5 Ground floor (normal)	28.9800	0.0000	0.0000
E6 Intermediate floor within a dwelling	30.6000	0.0500	1.5300
E16 Corner (normal)	10.2000	-0.0900	-0.9180
E17 Corner (inverted - internal area greater than external area)	15.0600	0.0600	0.9036
E10 Eaves (insulation at ceiling level)	11.2200	0.0600	0.6732
E12 Gable (insulation at ceiling level)			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.2346 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss	(33) + (36) + (36a) =		70.5927 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204 (38)
Average = Sum(39)m / 12 =	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819 (40)
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												2.6614 (42)
Hot water usage for mixer showers												68.5789 (42a)
Hot water usage for baths												29.6273 (42b)
Hot water usage for other uses												41.8854 (42c)
Average daily hot water use (litres/day)												129.1106 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	140.4558	137.4567	133.8043	128.2503	123.7402	118.8914	117.0280	120.6647	124.5000	129.5904	135.2299	140.0916 (44)
Distribution loss (46)m = 0.15 x (45)m	222.4477	195.7365	205.6522	175.5683	166.5781	146.1909	141.5352	149.4080	153.5210	175.8530	192.6598	219.3496 (45)
Water storage loss:												2144.5003
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6588 (55)
Total storage loss												20.4228 (56)
If cylinder contains dedicated solar storage												20.4228 (57)
Primary loss												23.2624 (59)
Combi loss												0.0000 (61)
Total heat required for water heating calculated for each month												266.1329 (62)
WWHRS												0.0000 (63a)
PV diverter												-0.0000 (63b)
Solar input												0.0000 (63c)
FGHRS												0.0000 (63d)
Output from w/h												266.1329 (64)
Electric shower(s)												0.0000 (64a)
Heat gains from water heating, kWh/month												108.9120 (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	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.9106	25.6782	20.8829	15.8097	11.8179	9.9772	10.7807	14.0132	18.8084	23.8816	27.8734	29.7141 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	364.2228	368.0023	358.4781	338.2022	312.6075	288.5521	272.4817	268.7022	278.2264	298.5023	324.0969	348.1523 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298 (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)	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559 (71)
Water heating gains (Table 5)	146.3871	143.8221	138.8811	128.0518	121.4185	114.4851	110.2266	113.7451	117.8702	125.5635	135.9447	145.0025 (72)
Total internal gains	646.3783	644.3603	625.0998	588.9214	552.7017	519.8722	500.3468	503.3181	521.7627	554.8052	594.7728	629.7267 (73)

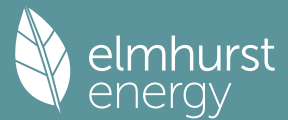
6. Solar gains

[Jan]												Gains
					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		W	
North					0.9700	9.0093	0.3300	0.0000	0.7700		2.2206 (74)	
East					6.3500	16.6316	0.3300	0.0000	0.7700		26.8357 (76)	
South					1.9100	39.6765	0.3300	0.0000	0.7700		19.2562 (78)	
West					13.8300	16.6316	0.3300	0.0000	0.7700		58.4469 (80)	
Solar gains	106.7594	208.4033	348.9271	511.9028	606.7075	630.6093	585.8089	498.6582	406.9680	246.1518	132.2646	89.7737 (83)
Total gains	753.1376	852.7635	974.0269	1100.8241	1159.4092	1150.4815	1086.1557	1001.9763	928.7308	800.9570	727.0373	719.5004 (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	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843
alpha	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856
util living area	1.0000	0.9999	0.9991	0.9867	0.8951	0.7097	0.5847	0.6437	0.8958	0.9975	0.9999	1.0000 (86)
Living	20.4181	20.4911	20.6361	20.8276	20.9647	20.9972	20.9997	20.9991	20.9715	20.7706	20.5555	20.3954
Non living	19.2641	19.3577	19.5433	19.7802	19.9155	19.9337	19.9344	19.9343	19.9226	19.7145	19.4403	19.2350
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.7023	20.4911	20.6361	20.8276	20.9647	20.9972	20.9997	20.9991	20.9715	20.7706	20.5555	20.4800 (87)
Th 2	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345 (88)
util rest of house	1.0000	0.9998	0.9982	0.9738	0.8291	0.6121	0.4777	0.5287	0.8106	0.9938	0.9998	1.0000 (89)
MIT 2	19.6672	19.3577	19.5433	19.7802	19.9155	19.9337	19.9344	19.9343	19.9226	19.7145	19.4403	19.3610 (90)
Living area fraction	19.7919	19.4942	19.6749	19.9064	20.0419	20.0618	20.0627	20.0626	20.0489	19.8417	19.5746	19.4958 (92)

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Temperature adjustment												0.0000
adjusted MIT	19.7919	19.4942	19.6749	19.9064	20.0419	20.0618	20.0627	20.0626	20.0489	19.8417	19.5746	19.4958 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	1.0000	0.9998	0.9978	0.9733	0.8367	0.6240	0.4907	0.5426	0.8212	0.9933	0.9998	1.0000	(94)
Useful gains	753.1060	852.5594	971.9249	1071.4668	970.0474	717.8467	532.9243	543.6967	762.6669	795.6134	726.8699	719.4791	(95)
Ext temp.	3.7000	4.1000	5.6000	8.0000	10.9000	13.5000	15.2000	15.1000	12.9000	9.6000	6.4000	3.6000	(96)
Heat loss rate W	1763.8825	1687.4107	1542.7927	1305.0934	1002.0718	719.2603	533.0189	543.9649	783.6142	1122.6274	1444.1097	1742.3890	(97)
Space heating kWh	752.0178	561.0200	424.7256	168.2112	23.8261	0.0000	0.0000	0.0000	0.0000	243.2984	516.4127	761.0450	(98a)
Space heating requirement - total per year (kWh/year)												3450.5568	
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	752.0178	561.0200	424.7256	168.2112	23.8261	0.0000	0.0000	0.0000	0.0000	243.2984	516.4127	761.0450	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3450.5568	
Space heating per m2										(98c) / (4) =		37.2068	(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 %)													242.2829 (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	752.0178	561.0200	424.7256	168.2112	23.8261	0.0000	0.0000	0.0000	0.0000	243.2984	516.4127	761.0450	(98)
Space heating efficiency (main heating system 1)	242.2829	242.2829	242.2829	242.2829	242.2829	0.0000	0.0000	0.0000	0.0000	242.2829	242.2829	242.2829	(210)
Space heating fuel (main heating system)	310.3883	231.5558	175.3015	69.4276	9.8340	0.0000	0.0000	0.0000	0.0000	100.4192	213.1445	314.1142	(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 requirement	266.1329	235.1941	249.3374	217.8443	210.2633	188.4669	185.2204	193.0932	195.7970	219.5382	234.9358	263.0348	(64)
Efficiency of water heater (217)m	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	(216)
Fuel for water heating, kWh/month	100.0038	88.3780	93.6926	81.8586	79.0099	70.8195	69.5996	72.5579	73.5739	82.4951	88.2810	98.8396	(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	3.8398	3.4682	3.8398	3.7160	3.8398	3.7160	3.8398	3.8398	3.7160	3.8398	3.7160	3.8398	(231)
Lighting	25.3053	20.3008	18.2787	13.3917	10.3442	8.4513	9.4363	12.2656	15.9319	20.9035	23.6104	26.0086	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-57.6441	-91.2125	-144.9833	-159.6831	-156.0754	-142.4226	-139.0832	-131.8795	-118.2641	-102.5813	-64.8868	-48.9952	(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	-22.7874	-59.8534	-159.3501	-306.3960	-442.2766	-470.6994	-444.8541	-347.6024	-236.5929	-101.3784	-33.3478	-17.3982	(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												1424.1852	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												266.1228	
Water heating fuel used												999.1094	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)													
mechanical ventilation fans (SFP = 0.1567)												45.2109	(230a)
Total electricity for the above, kWh/year												45.2109	(231)
Electricity for lighting (calculated in Appendix L)												204.2282	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-4000.2477	(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												-1327.5139	(238)

10a. Fuel costs - using BEDF prices (574)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1424.1852	28.4300	404.8958	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	999.1094	28.4300	284.0468	(247)

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Energy for instantaneous electric shower(s)	0.0000	28.4300	0.0000 (247a)
Pumps, fans and electric keep-hot	45.2109	28.4300	12.8535 (249)
Energy for lighting	204.2282	28.4300	58.0621 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1357.7109	28.4300	-385.9972
PV Unit electricity exported	-2642.5367	5.8100	-153.5314
Total			-539.5286 (252)
Total energy cost			220.3296 (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	1424.1852	0.1564	222.7320 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	999.1094	0.1410	140.8982 (264)
Space and water heating			363.6302 (265)
Pumps, fans and electric keep-hot	45.2109	0.1387	6.2713 (267)
Energy for lighting	204.2282	0.1443	29.4764 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1357.7109	0.1348	-183.0719
PV Unit electricity exported	-2642.5367	0.1211	-319.8834
Total			-502.9553 (269)
Total CO2, kg/year			-103.5774 (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	1424.1852	1.5790	2248.7795 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	999.1094	1.5215	1520.1059 (278)
Space and water heating			3768.8854 (279)
Pumps, fans and electric keep-hot	45.2109	1.5128	68.3951 (281)
Energy for lighting	204.2282	1.5338	313.2520 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1357.7109	1.4984	-2034.3931
PV Unit electricity exported	-2642.5367	0.4442	-1173.7195
Total			-3208.1127 (283)
Total Primary energy kWh/year			942.4199 (286)

SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating:	A 100
Current environmental impact rating:	A 102

N Solar water heating			Recommended
U Solar photovoltaic panels			Already installed
V2 Wind turbine			Not applicable
Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 37	-20 kg (19.7%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£37	0.22 kg/m²	A 101
Total Savings	£37	0.22 kg/m²	A 102
Potential energy efficiency rating:			A 101
Potential environmental impact rating:			A 102

Fuel prices for cost data on this page from database revision number 574 TEST (30 Jun 2025)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current £760	Potential £711	Saving £49
Electricity			
Space heating	£418	£446	-£28
Water heating	£284	£207	£78
Lighting	£58	£58	£0
Generated (PV)	-£540	-£527	-£12
Total cost of fuels	£220	£184	£37
Total cost of uses	£220	£184	£38
Delivered energy	-14 kWh/m²	-16 kWh/m²	2 kWh/m²
Carbon dioxide emissions	-0.1 tonnes	-0.1 tonnes	0.0 tonnes
CO2 emissions per m²	-1 kg/m²	-1 kg/m²	0 kg/m²
Primary energy	10 kWh/m²	8 kWh/m²	2 kWh/m²

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1. Overall dwelling characteristics

Main dwelling	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	46.3700 (1b)	x 2.4000 (2b)	= 111.2880 (1b) - (3b)
First floor	46.3700 (1c)	x 2.7000 (2c)	= 125.1990 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 236.4870 (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)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2167	0.2125	0.2083	0.1870	0.1827	0.1615	0.1615	0.1573	0.1700	0.1827	0.1913	0.1998 (22b)
Mechanical extract ventilation - decentralised												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												
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
Main dwelling							
Door			2.1500	1.0000	2.1500		(26)
Window			23.0600	1.1450	26.4046		(27)
GF			46.3700	0.1100	5.1007	75.0000	3477.7500 (28a)
Main	147.7980	25.2100	122.5880	0.1800	22.0658	110.0000	13484.6800 (29a)
Flat	46.3700		46.3700	0.1000	4.6370	9.0000	417.3300 (30)
Total net area of external elements Aum(A, m2)			240.5380				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	60.3581			(33)
Main dwelling							
Internal Wall 1			555.4400			75.0000	41658.0002 (32c)
Internal Floor 1			46.3700			18.0000	834.6600 (32d)
Internal Ceiling 1			46.3700			9.0000	417.3300 (32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	60289.7502 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		650.0944 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	13.7400	0.0500	0.6870
E3 Sill	13.7400	0.0500	0.6870
E4 Jamb	40.7000	0.0500	2.0350
E5 Ground floor (normal)	28.9800	0.1600	4.6368
E6 Intermediate floor within a dwelling	28.9800	0.0000	0.0000
E16 Corner (normal)	30.6000	0.0500	1.5300
E17 Corner (inverted - internal area greater than external area)	10.2000	-0.0900	-0.9180
E10 Eaves (insulation at ceiling level)	15.0600	0.0600	0.9036
E12 Gable (insulation at ceiling level)	11.2200	0.0600	0.6732
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.2346 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 70.5927 (37)

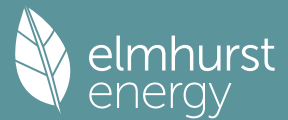
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204 (38)
Heat transfer coeff	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131 (39)
Average = Sum(39)m / 12 =												109.6131

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6614 (42)
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Hot water usage for mixer showers	68.8427	67.8081	66.3005	63.4160	61.2874	58.9135	57.5642	59.0604	60.7004	63.2493	66.1957	68.5789 (42a)
Hot water usage for baths	29.7278	29.2863	28.6646	27.5182	26.6599	25.7081	25.1940	25.8113	26.4835	27.5020	28.6720	29.6273 (42b)
Hot water usage for other uses	41.8854	40.3623	38.8392	37.3161	35.7930	34.2699	34.2699	35.7930	37.3161	38.8392	40.3623	41.8854 (42c)
Average daily hot water use (litres/day)												129.1106 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	140.4558	137.4567	133.8043	128.2503	123.7402	118.8914	117.0280	120.6647	124.5000	129.5904	135.2299	140.0916 (44)
Distribution loss (46)m = 0.15 x (45)m	222.4477	195.7365	205.6522	175.5683	166.5781	146.1909	141.5352	149.4080	153.5210	175.8530	192.6598	219.3496 (45)
Water storage loss:	33.3672	29.3605	30.8478	26.3352	24.9867	21.9286	21.2303	22.4112	23.0282	26.3779	28.8990	32.9024 (46)
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6588 (55)
Total storage loss	20.4228	18.4464	20.4228	19.7640	20.4228	19.7640	20.4228	20.4228	19.7640	20.4228	19.7640	20.4228 (56)
If cylinder contains dedicated solar storage	12.7643	11.5290	12.7643	12.3525	12.7643	12.3525	12.7643	12.3525	12.7643	12.3525	12.7643	12.7643 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	258.4744	228.2767	240.2831	203.6792	189.8104	168.4487	164.5349	173.3383	182.9826	210.4839	227.5243	255.3762 (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)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
If combined cylinder, total volume of cylinder												200.0000 (H13)
Effective solar volume												112.5000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.1892 (H16)
Heat delivered to hot water												649.2173 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												649.2173
Solar input	-0.0000	-19.9524	-62.0809	-83.3374	-106.7996	-98.1850	-97.3378	-86.1508	-61.2225	-32.9700	-1.1808	-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	258.4744	208.3242	178.2021	120.3418	83.0109	70.2636	67.1972	87.1874	121.7601	177.5139	226.3435	255.3762 (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	102.7852	91.1145	96.0841	80.8652	73.9731	66.4147	65.4602	68.8223	74.6150	86.1758	91.9510	101.7550 (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	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.9106	25.6782	20.8829	15.8097	11.8179	9.9772	10.7807	14.0132	18.8084	23.8816	27.8734	29.7141 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	364.2228	368.0023	358.4781	338.2022	312.6075	288.5521	272.4817	268.7022	278.2264	298.5023	324.0969	348.1523 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298 (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)	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559 (71)
Water heating gains (Table 5)	138.1521	135.5871	129.1453	112.3128	99.4262	92.2426	87.9842	92.5031	103.6320	115.8277	127.7097	136.7675 (72)
Total internal gains	638.1433	636.1253	615.3640	573.1824	530.7094	497.6297	478.1043	482.0762	507.5245	545.0694	586.5378	621.4917 (73)

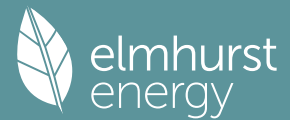
6. Solar gains

[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				0.9700	10.6334		0.3300		0.0000		0.7700		2.6209 (74)
East				6.3500	19.6403		0.3300		0.0000		0.7700		31.6903 (76)
South				1.9100	46.7521		0.3300		0.0000		0.7700		22.6902 (78)
West				13.8300	19.6403		0.3300		0.0000		0.7700		69.0199 (80)
Solar gains	126.0212	239.1798	380.2951	540.3590	654.0760	667.0077	635.9979	550.9844	437.0276	279.8129	155.7025	104.6105	(83)
Total gains	764.1645	875.3051	995.6591	1113.5414	1184.7853	1164.6374	1114.1022	1033.0606	944.5521	824.8823	742.2403	726.1022	(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	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843
alpha	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856
util living area	1.0000	0.9998	0.9980	0.9743	0.8338	0.6015	0.4329	0.4880	0.7865	0.9924	0.9998	1.0000 (86)

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Living	20.4572	20.5472	20.6968	20.8771	20.9840	20.9995	21.0000	21.0000	20.9932	20.8364	20.6022	20.4323
Non living	19.3143	19.4296	19.6203	19.8357	19.9275	19.9344	19.9345	19.9345	19.9327	19.7949	19.5002	19.2823
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.7223	20.5472	20.6968	20.8771	20.9840	20.9995	21.0000	21.0000	20.9932	20.8364	20.6022	20.5117 (87)
Th 2	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345 (88)
util rest of house												
	0.9999	0.9996	0.9959	0.9504	0.7528	0.5020	0.3281	0.3750	0.6743	0.9812	0.9996	1.0000 (89)
MIT 2	19.6872	19.4296	19.6203	19.8357	19.9275	19.9344	19.9345	19.9345	19.9327	19.7949	19.5002	19.3998 (90)
Living area fraction									FLA = Living area /	(4) =		0.1204 (91)
MIT	19.8119	19.5642	19.7500	19.9612	20.0548	20.0627	20.0628	20.0628	20.0605	19.9203	19.6330	19.5337 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8119	19.5642	19.7500	19.9612	20.0548	20.0627	20.0628	20.0628	20.0605	19.9203	19.6330	19.5337 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9999	0.9995	0.9953	0.9512	0.7627	0.5140	0.3407	0.3886	0.6882	0.9810	0.9995	1.0000 (94)
Useful gains	764.1097	874.8601	991.0247	1059.2149	903.5984	598.6102	379.5678	401.4849	650.0456	809.2097	741.8915	726.0677 (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	1700.3059	1607.3892	1452.3698	1212.4481	915.7917	598.7809	379.5692	401.4912	653.3445	1021.6273	1373.7774	1680.7746 (97)
Space heating kWh	696.5300	492.2595	343.2407	110.3279	9.0718	0.0000	0.0000	0.0000	0.0000	158.0387	454.9578	710.3020 (98a)
Space heating requirement - total per year (kWh/year)												2974.7284
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	696.5300	492.2595	343.2407	110.3279	9.0718	0.0000	0.0000	0.0000	0.0000	158.0387	454.9578	710.3020 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2974.7284
Space heating per m2										(98c) / (4) =		32.0760 (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 %)												242.2829 (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	696.5300	492.2595	343.2407	110.3279	9.0718	0.0000	0.0000	0.0000	0.0000	158.0387	454.9578	710.3020 (98)
Space heating efficiency (main heating system 1)	242.2829	242.2829	242.2829	242.2829	242.2829	0.0000	0.0000	0.0000	0.0000	242.2829	242.2829	242.2829 (210)
Space heating fuel (main heating system)	287.4862	203.1755	141.6694	45.5368	3.7443	0.0000	0.0000	0.0000	0.0000	65.2290	187.7796	293.1705 (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	258.4744	208.3242	178.2021	120.3418	83.0109	70.2636	67.1972	87.1874	121.7601	177.5139	226.3435	255.3762 (64)
Efficiency of water heater (217)m	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228 (216)
Fuel for water heating, kWh/month	97.1260	78.2812	66.9624	45.2204	31.1927	26.4027	25.2504	32.7621	45.7533	66.7037	85.0523	95.9618 (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	10.6344	9.6052	10.6344	10.2913	10.6344	10.2913	10.6344	10.6344	10.2913	10.6344	10.2913	10.6344 (231)
Lighting	25.3053	20.3008	18.2787	13.3917	10.3442	8.4513	9.4363	12.2656	15.9319	20.9035	23.6104	26.0086 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-65.7870	-99.4202	-146.9561	-151.3025	-143.6180	-130.1285	-127.9165	-125.5751	-116.9494	-106.9931	-73.0641	-55.5117 (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	-29.2327	-74.0916	-184.9734	-340.9726	-501.7473	-518.6419	-506.3200	-404.5024	-264.3722	-125.0361	-42.6712	-21.9166 (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												1227.7914 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												266.1228
Water heating fuel used												696.6690 (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)												45.2109 (230a)
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												125.2109 (231)
Electricity for lighting (calculated in Appendix L)												204.2282 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-4357.7003 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)

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Energy used 0.0000 (237)
Total delivered energy for all uses -2103.8008 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1227.7914	16.4900	202.4628 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	696.6690	16.4900	114.8807 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	45.2109	16.4900	7.4553 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	204.2282	16.4900	33.6772 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1343.2223	16.4900	-221.4974
PV Unit electricity exported	-3014.4781	5.5900	-168.5093
Total			-390.0067 (252)
Total energy cost			-18.3386 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	-0.0479 (257)
SAP value		100.7769
SAP rating (Section 12)		101 (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	1227.7914	0.1572	193.0624 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	696.6690	0.1464	101.9645 (264)
Space and water heating			295.0269 (265)
Pumps, fans and electric keep-hot	125.2109	0.1387	17.3683 (267)
Energy for lighting	204.2282	0.1443	29.4764 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1343.2223	0.1359	-182.4872
PV Unit electricity exported	-3014.4781	0.1215	-366.1127
Total			-548.5999 (269)
Total CO2, kg/year			-206.7282 (272)
CO2 emissions per m2			-2.2300 (273)
EI value			102.0112
EI rating			102 (274)
EI band			A

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

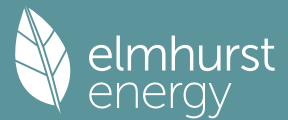
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	46.3700 (1b)	x 2.4000 (2b)	= 111.2880 (1b) - (3b)
First floor	46.3700 (1c)	x 2.7000 (2c)	= 125.1990 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	236.4870 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2000 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)

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Infiltration rate adjusted to include shelter factor

(21) = (18) x (20) = 0.1700 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.3000	5.2000	5.2000	4.7000	4.9000	4.2000	4.3000	4.3000	4.2000	4.7000	4.8000	5.4000	(22)
Adj infilt rate	1.3250	1.3000	1.3000	1.1750	1.2250	1.0500	1.0750	1.0750	1.0500	1.1750	1.2000	1.3500	(22a)
	0.2253	0.2210	0.2210	0.1998	0.2083	0.1785	0.1827	0.1827	0.1785	0.1998	0.2040	0.2295	(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	
Main dwelling								
Door			2.1500	1.0000	2.1500			(26)
Window			23.0600	1.1450	26.4046			(27)
GF			46.3700	0.1100	5.1007	75.0000	3477.7500	(28a)
Main	147.7980	25.2100	122.5880	0.1800	22.0658	110.0000	13484.6800	(29a)
Flat	46.3700		46.3700	0.1000	4.6370	9.0000	417.3300	(30)
Total net area of external elements Aum(A, m2)			240.5380					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	60.3581		(33)
Main dwelling								
Internal Wall 1			555.4400			75.0000	41658.0002	(32c)
Internal Floor 1			46.3700			18.0000	834.6600	(32d)
Internal Ceiling 1			46.3700			9.0000	417.3300	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 60289.7502 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 650.0944 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	13.7400	0.0500	0.6870
E3 Sill	13.7400	0.0500	0.6870
E4 Jamb	40.7000	0.0500	2.0350
E5 Ground floor (normal)	28.9800	0.1600	4.6368
E6 Intermediate floor within a dwelling	28.9800	0.0000	0.0000
E16 Corner (normal)	30.6000	0.0500	1.5300
E17 Corner (inverted - internal area greater than external area)	10.2000	-0.0900	-0.9180
E10 Eaves (insulation at ceiling level)	15.0600	0.0600	0.9036
E12 Gable (insulation at ceiling level)	11.2200	0.0600	0.6732

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.2346 (36)

Point Thermal Bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 70.5927 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	39.0204	(38)
Average = Sum(39)m / 12 =	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	109.6131	(39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	1.1819	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.6614 (42)
Hot water usage for mixer showers													
Hot water usage for baths	68.8427	67.8081	66.3005	63.4160	61.2874	58.9135	57.5642	59.0604	60.7004	63.2493	66.1957	68.5789	(42a)
Hot water usage for other uses	29.7278	29.2863	28.6646	27.5182	26.6599	25.7081	25.1940	25.8113	26.4835	27.5020	28.6720	29.6273	(42b)
Average daily hot water use (litres/day)	41.8854	40.3623	38.8392	37.3161	35.7930	34.2699	34.2699	35.7930	37.3161	38.8392	40.3623	41.8854	(42c)
													129.1106 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	140.4558	137.4567	133.8043	128.2503	123.7402	118.8914	117.0280	120.6647	124.5000	129.5904	135.2299	140.0916	(44)
Energy content (annual)	222.4477	195.7365	205.6522	175.5683	166.5781	146.1909	141.5352	149.4080	153.5210	175.8530	192.6598	219.3496	(45)
Distribution loss (46)m = 0.15 x (45)m													
Total storage loss	33.3672	29.3605	30.8478	26.3352	24.9867	21.9286	21.2303	22.4112	23.0282	26.3779	28.8990	32.9024	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2200 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.6588 (55)
Total storage loss	20.4228	18.4464	20.4228	19.7640	20.4228	19.7640	20.4228	20.4228	19.7640	20.4228	19.7640	20.4228	(56)
If cylinder contains dedicated solar storage													
Primary loss	12.7643	11.5290	12.7643	12.3525	12.7643	12.3525	12.7643	12.7643	12.3525	12.7643	12.3525	12.7643	(57)
Combi loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	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)
WWHRS	258.4744	228.2767	240.2831	203.6792	189.8104	168.4487	164.5349	173.3383	182.9826	210.4839	227.5243	255.3762	(62)
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	(63a)
Aperture area of solar collector	-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)
Zero-loss collector efficiency													3.0000 (H1)
Collector linear heat loss coefficient													0.8000 (H2)
Collector 2nd order heat loss coefficient													1.8000 (H3)
Collector loop efficiency													0.0000 (H4)
Incidence angle modifier													0.9000 (H5)
Overall heat loss coefficient of system													1.0000 (H6)
Heat loss coefficient of collector loop													0.8000 (H8)
Dedicated solar storage volume													6.5000 (H10)
If combined cylinder, total volume of cylinder													3.9667 (H11)
Effective solar volume													75.0000 (H12)
													200.0000 (H13)
													112.5000 (H14)

Full SAP Calculation Printout



Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.1892 (H16)
Heat delivered to hot water												570.1775 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												570.1775
Solar input	-0.0000	-11.9873	-53.3090	-76.7949	-97.4682	-91.2784	-87.5392	-74.9295	-53.7859	-23.0849	-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	258.4744	216.2893	186.9741	126.8843	92.3422	77.1703	76.9958	98.4087	129.1967	187.3990	227.5243	255.3762 (64)
								Total per year (kWh/year) = Sum(64)m =				1933.0352 (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	102.7852	91.1145	96.0841	80.8652	73.9731	66.4147	65.4602	68.8223	74.6150	86.1758	91.9510	101.7550 (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	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	159.6839	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.9106	25.6782	20.8829	15.8097	11.8179	9.9772	10.7807	14.0132	18.8084	23.8816	27.8734	29.7141	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	364.2228	368.0023	358.4781	338.2022	312.6075	288.5521	272.4817	268.7022	278.2264	298.5023	324.0969	348.1523	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	53.6298	(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)	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	-106.4559	(71)
Water heating gains (Table 5)	138.1521	135.5871	129.1453	112.3128	99.4262	92.2426	87.9842	92.5031	103.6320	115.8277	127.7097	136.7675	(72)
Total internal gains	638.1433	636.1253	615.3640	573.1824	530.7094	497.6297	478.1043	482.0762	507.5245	545.0694	586.5378	621.4917	(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						0.9700	9.0093	0.3300	0.0000			0.7700	2.2206 (74)	
East						6.3500	16.6316	0.3300	0.0000			0.7700	26.8357 (76)	
South						1.9100	39.6765	0.3300	0.0000			0.7700	19.2562 (78)	
West						13.8300	16.6316	0.3300	0.0000			0.7700	58.4469 (80)	
Solar gains	106.7594	208.4033	348.9271	511.9028	606.7075	630.6093	585.8089	498.6582	406.9680	246.1518	132.2646	89.7737 (83)		
Total gains	744.9026	844.5285	964.2911	1085.0851	1137.4169	1128.2390	1063.9132	980.7344	914.4926	791.2212	718.8023	711.2654 (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	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	152.7843	
alpha	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	11.1856	
util living area	1.0000	0.9999	0.9992	0.9883	0.9050	0.7228	0.5968	0.6573	0.9037	0.9978	0.9999	1.0000	(86)
Living	20.4139	20.4869	20.6312	20.8205	20.9604	20.9966	20.9996	20.9989	20.9687	20.7658	20.5513	20.3913	
Non living	19.2587	19.3524	19.5370	19.7721	19.9127	19.9336	19.9344	19.9343	19.9211	19.7085	19.4349	19.2296	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.7002	20.4869	20.6312	20.8205	20.9604	20.9966	20.9996	20.9989	20.9687	20.7658	20.5513	20.4764 (87)	
Th 2	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	19.9345	(88)
util rest of house	1.0000	0.9998	0.9984	0.9765	0.8413	0.6239	0.4877	0.5401	0.8207	0.9945	0.9998	1.0000 (89)	
MIT 2	19.6651	19.3524	19.5370	19.7721	19.9127	19.9336	19.9344	19.9343	19.9211	19.7085	19.4349	19.3566 (90)	
Living area fraction												0.1204 (91)	
MIT	19.7898	19.4890	19.6688	19.8984	20.0389	20.0616	20.0627	20.0625	20.0473	19.8359	19.5694	19.4915 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.7898	19.4890	19.6688	19.8984	20.0389	20.0616	20.0627	20.0625	20.0473	19.8359	19.5694	19.4915 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	1.0000	0.9998	0.9980	0.9760	0.8485	0.6360	0.5009	0.5543	0.8310	0.9940	0.9998	1.0000	(94)
Ext temp.	744.8747	844.3448	962.3925	1059.0211	965.0830	717.5366	532.9001	543.6272	759.9707	786.4647	718.6543	711.2467 (95)	
Heat loss rate W	3.7000	4.1000	5.6000	8.0000	10.9000	13.5000	15.2000	15.1000	12.9000	9.6000	6.4000	3.6000 (96)	
Space heating kWh	1763.6476	1686.8379	1542.1261	1304.2215	1001.7398	719.2384	533.0169	543.9592	783.4338	1121.9863	1443.5369	1741.9164 (97)	
Space heating requirement - total per year (kWh/year)	757.9671	566.1554	431.3218	176.5443	27.2726	0.0000	0.0000	0.0000	0.0000	249.6281	521.9154	766.8183 (98a)	
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)	757.9671	566.1554	431.3218	176.5443	27.2726	0.0000	0.0000	0.0000	0.0000	249.6281	521.9154	766.8183 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												3497.6230	
Space heating per m2												37.7143 (99)	

9a. Energy requirements - Individual heating systems, including micro-CHP

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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 %)													242.2829 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
757.9671	566.1554	431.3218	176.5443	27.2726	0.0000	0.0000	0.0000	0.0000	0.0000	249.6281	521.9154	766.8183	(98)
Space heating efficiency (main heating system 1)	242.2829	242.2829	242.2829	242.2829	242.2829	0.0000	0.0000	0.0000	0.0000	242.2829	242.2829	242.2829	(210)
Space heating fuel (main heating system)	312.8438	233.6753	178.0241	72.8670	11.2565	0.0000	0.0000	0.0000	0.0000	103.0317	215.4157	316.4971	(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	258.4744	216.2893	186.9741	126.8843	92.3422	77.1703	76.9958	98.4087	129.1967	187.3990	227.5243	255.3762	(64)
Efficiency of water heater	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	266.1228	(216)
Fuel for water heating, kWh/month	97.1260	81.2742	70.2586	47.6788	34.6991	28.9980	28.9324	36.9787	48.5478	70.4182	85.4960	95.9618	(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	10.6344	9.6052	10.6344	10.2913	10.6344	10.2913	10.6344	10.6344	10.2913	10.6344	10.2913	10.6344	(231)
Lighting	25.3053	20.3008	18.2787	13.3917	10.3442	8.4513	9.4363	12.2656	15.9319	20.9035	23.6104	26.0086	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-57.7294	-91.2571	-143.6372	-154.6262	-144.6540	-129.7151	-127.1901	-123.3715	-114.2100	-102.3658	-65.0297	-49.0613	(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	-22.7021	-59.8088	-160.6962	-311.4529	-453.6981	-483.4068	-456.7471	-356.1104	-240.6470	-101.5939	-33.2050	-17.3320	(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													1443.6113 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													266.1228
Water heating fuel used													726.3696 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.7980, total flow = 37.0000, SFP = 0.1567)													
mechanical ventilation fans (SFP = 0.1567)													45.2109 (230a)
pump for solar water heating													80.0000 (230g)
Total electricity for the above, kWh/year													125.2109 (231)
Electricity for lighting (calculated in Appendix L)													204.2282 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-4000.2477 (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													-1500.8277 (238)

10a. Fuel costs - using BEDF prices (574)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1443.6113	28.4300	410.4187	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	726.3696	28.4300	206.5069	(247)
Energy for instantaneous electric shower(s)	0.0000	28.4300	0.0000	(247a)
Pumps, fans and electric keep-hot	45.2109	28.4300	12.8535	(249)
Pump for solar water heating	80.0000	28.4300	22.7440	(249)
Energy for lighting	204.2282	28.4300	58.0621	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1302.8473	28.4300	-370.3995	
PV Unit electricity exported	-2697.4003	5.8100	-156.7190	
Total			-527.1185	(252)
Total energy cost			183.4666	(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	1443.6113	0.1563	225.6542	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	726.3696	0.1457	105.8676	(264)
Space and water heating			331.5218	(265)
Pumps, fans and electric keep-hot	125.2109	0.1387	17.3683	(267)
Energy for lighting	204.2282	0.1443	29.4764	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1302.8473	0.1354	-176.3668	

Full SAP Calculation Printout



PV Unit electricity exported	-2697.4003	0.1209	-326.0118
Total			-502.3785 (269)
Total CO2, kg/year			-124.0120 (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	1443.6113	1.5787	2279.0260 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	726.3696	1.5391	1117.9891 (278)
Space and water heating			3397.0151 (279)
Pumps, fans and electric keep-hot	125.2109	1.5128	189.4191 (281)
Energy for lighting	204.2282	1.5338	313.2520 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1302.8473	1.5004	-1954.7972
PV Unit electricity exported	-2697.4003	0.4435	-1196.1649
Total			-3150.9621 (283)
Total Primary energy kWh/year			748.7242 (286)

Predicted Energy Assessment



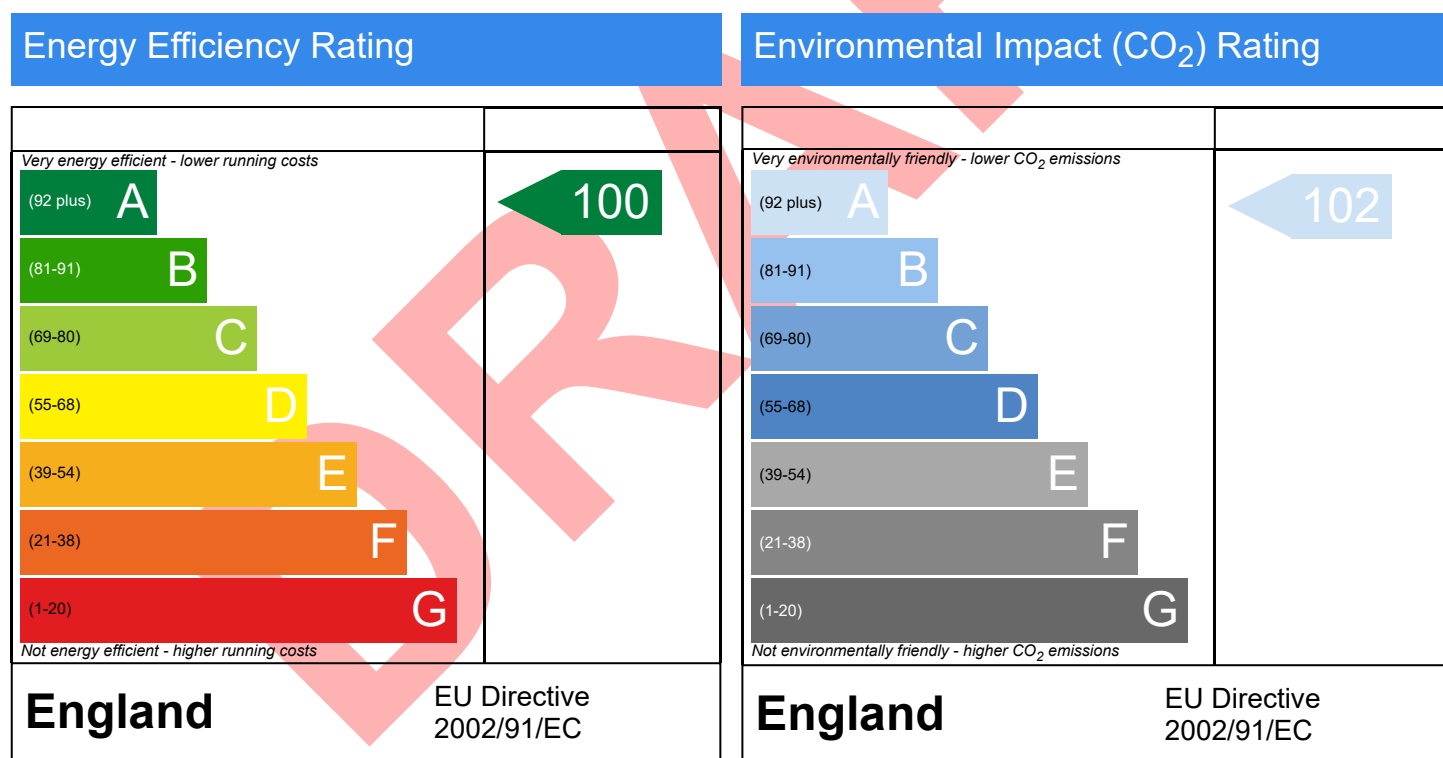
Land adj to , 220 Ainsworth Road, BURY, BL8 2LR

Dwelling type:
Date of assessment:
Produced by:
Total floor area:
DRRN:

House, Detached
01/08/2025
Paul Goddard
92.74 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO₂) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

Thermal Bridging

Property Reference	79053	Issued on Date	01/08/2025
Assessment Reference	001	Prop Type Ref	Detached House
Property	Land adj to , 220 Ainsworth Road, BURY, BL8 2LR		

SAP Rating	100 A	DER	-1.79	TER	12.12
Environmental	102 A	% DER < TER			114.77
CO ₂ Emissions (t/year)	-0.1	DFEE	43.17	TFEE	43.48
Compliance Check	See BREL	% DFEE < TFEE			0.72
% DPER < TPER	90.75	DPER	5.86	TPER	63.38

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

	Junction details	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.050	13.74	0.69	Thermally Broken
External wall	E3 Sill	Independently assessed	0.050	13.74	0.69	To be modelled
External wall	E4 Jamb	Independently assessed	0.050	40.70	2.04	To be modelled
External wall	E5 Ground floor (normal)	Independently assessed	0.160	28.98	4.64	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	28.98	0.00	
External wall	E16 Corner (normal)	Independently assessed	0.050	30.60	1.53	To be modelled
External wall	E17 Corner (inverted – internal area greater than external area)	Independently assessed	-0.090	10.20	-0.92	To be modelled
External wall	E10 Eaves (insulation at ceiling level)	Independently assessed	0.060	15.06	0.90	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.060	11.22	0.67	

Total: 193.22 W/mK:
Y-Value: 0.04 W/m²K:

Energy Report



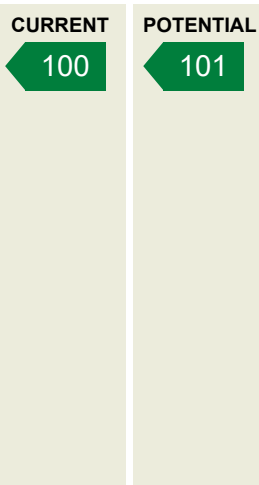
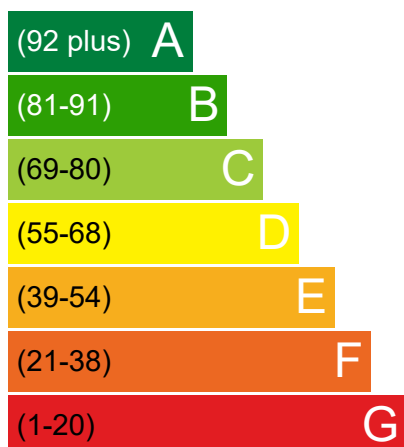
Dwelling Address	Land adj to , 220 Ainsworth Road, BURY, BL8 2LR
Reference	79053-001
Assessment Date	01/08/2025
Submission Date	
Property Type	House, Detached
Total Floor Area	93

This Energy Report has been generated using the UK's National Calculation Methodology for dwellings, Standard Assessment Procedure (SAP). This methodology is used to assess the energy efficiency of dwellings which is calculated based on a dwelling's heating, hot water, ventilation and lighting usage.

This document is not an Energy Performance Certificate (EPC) as required by the Energy Performance of Buildings Regulations

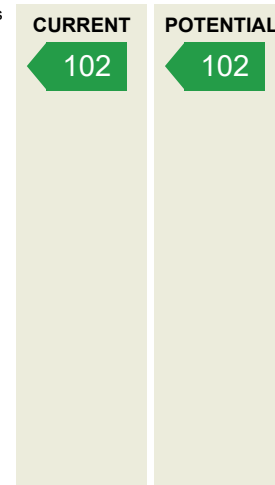
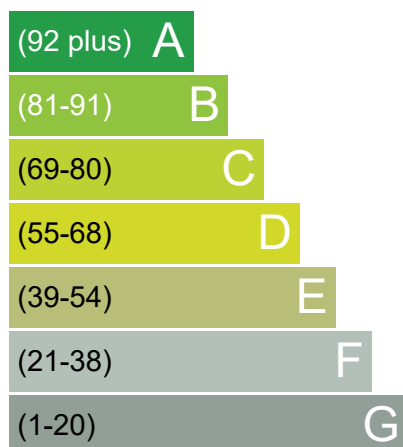
Energy Efficiency Rating

Most energy efficient - lower running costs

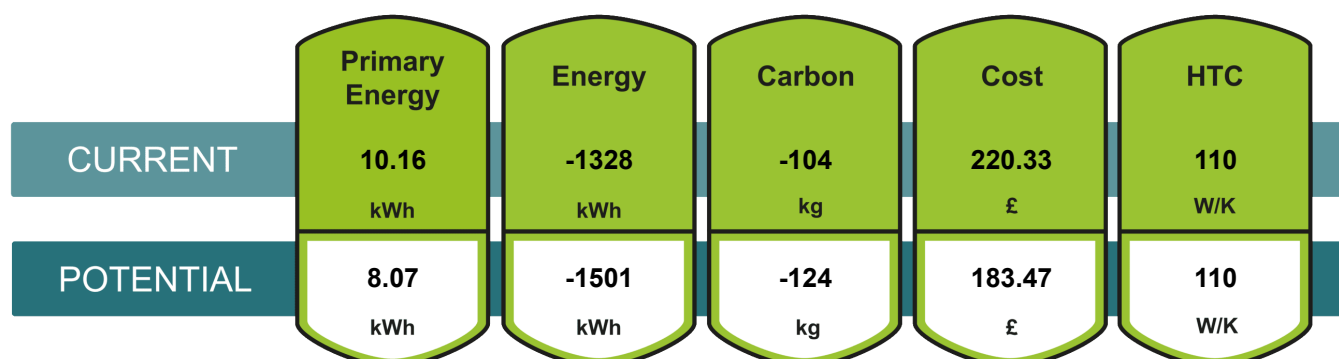


Carbon Dioxide (CO2) Emissions Rating

Very environmentally friendly - lower CO2 emissions



Additional ratings for your home



Breakdown of property's energy performance

Each feature is assessed as one of the following:

Very Poor	Poor	Average	Good	Very Good
-----------	------	---------	------	-----------

Feature	Description	Energy Performance
Walls	Average thermal transmittance 0.18 W/m ² K	Very Good
Roof	Average thermal transmittance 0.1 W/m ² K	Very Good
Floor	Average thermal transmittance 0.11 W/m ² K	Very Good
Windows	High performance glazing	Very Good
Main heating	Air source heat pump, radiators, electric	Good
Main heating controls	Time and temperature zone control	Very Good
Secondary heating	None	
Hot water	From main system	Good
Lighting	Good lighting efficiency	Good
Air tightness	Air permeability [AP50] = 4.0 m ³ /h.m ² (assumed)	Good

Recommendations

The recommended measures provided below will help to improve the energy efficiency of the dwelling. To reach the dwelling's potential energy rating all of the recommended measures shown below would need to be installed. Having these measures installed individually or in any other order may give a different result when compared with the cumulative potential rating.

Recommended measures	Cumulative savings (per year)	Cumulative rating	Typical costs	Incremental savings (per year)	Cumulative CO2 rating
Solar water heating	£37	A 101	£4,000 - £7,000	£37	A 102

The typical cost is based on average installation prices across the country so may not be representative of the actual costs in your area.

Estimated energy costs of the dwelling

The table below shows the estimated running costs of the space and water heating and lighting within the dwelling. It does not include the energy used from household appliances. The estimated annual costs after potential improvements indicates the total energy cost if all recommended measures named above were installed.

		Estimated annual costs	Estimated annual costs after potential improvements	Potential future savings
Lighting		£58	£58	
Heating		£418	£446	
Hot Water		£284	£207	
New Technologies e.g. Impact of PV		-(£540)	-(£527)	
TOTAL		£220	£183	

Estimated energy use and potential savings



Space Heating

1424

kWh per year



Water Heating

999

kWh per year

About this document

Created by:
Company/Trading name:
Phone number:
Email address:

Disclaimer

This Energy Report should not under any circumstances be treated as a Condition Survey and cannot be used to indicate that any element of the dwelling (e.g. heating system) is working correctly.

This Energy Report must not be used in situations where an Energy Performance Certificate (EPC) is required.

This Energy Report is generated from a set of data inputs which may not reflect the actual dimensions, services or construction of the dwelling.

The calculation used to generate this report reflects the SAP Methodology current at the time of report generation.

Glossary terms for additional metrics

Primary Energy	The measure of the energy required for lighting, heating and hot water in a property. This includes the efficiency of the property's heating system, power station efficiency for electricity and the energy used to produce the fuel and deliver it to the property.
Energy Used	The estimated amount of fuel energy for lighting, heating and hot water for the property. The estimate is based on typical usage which is likely to be different to actual consumption.
Carbon (CO ₂)	The current emissions based on the energy estimates.
Cost	The estimated cost of energy. The cost of each unit of fuel is based on an industry standard which is likely to be different to those the occupier actually pays.
Heat Transfer Coefficient	Heat flow through the property envelope where internal and external temperatures are different.