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your energy assessor

ENERGY STRATEGY

Compliance with BCS14

PROJECT NAME
14 Marlborough St

DATE
6th February 2025

ASSESSOR
Lee Humphries

Energy Strategy

Project: 5752KJ - 2024.12 SAP (14 Marlborough St - CJ Hole)

Contents

Energy Strategy

Project: 5752KJ - 2024.12 SAP (14 Marlborough St - CJ Hole)

Executive Summary

This Energy Assessment has been compiled to demonstrate compliance with the Bristol City Council Policy BCS14 (from the Development Framework Core Strategy).

The proposal is for the existing property at 14 Marlborough St, Eastville, Bristol, BS5 6RH to be converted to a house in multiple occupation.

Following the methodology outlined in the Climate Change and Sustainability – Practice Note (including the Practice Note Addendum – January 2023), SAP calculations have been completed in stages to demonstrate a 20% reduction in regulated carbon emissions.

Firstly, SAP calculations achieving Part L TER and TFEE compliance (2021 edition incorporating 2023 amendments – for use in England) were modelled to provide 'baseline' energy demand and emissions. Then, additional measures were applied to provide 'residual' energy demand and emissions. Finally, appropriate decentralised renewables were included in the SAP calculations to provide the final energy demand and emissions figures for comparison, as well as to achieve TPER compliance and thus full Building Regulations compliance. More detail is provided in the following sections. The carbon emission factors used in this assessment are relevant to the current Part L.

To summarize the results, the total reduction in carbon emissions from on-site renewables is as follows:

Total CO_2 Reduction Beyond Residual Emissions

74.11%

Total CO_2 Reduction Beyond Part L TER

76.72%

Result

Pass

Design Principles to Reduce Energy Consumption and Carbon Emissions

Fabric

With the change to Part L of the building regulations in 2022, lower U-values are now required in order to achieve minimum elemental compliance.

All new and upgraded thermal elements will meet or exceed the minimum requirements of Part L of the Building Regulations.

Fenestration and Solar Gain

Low U-values will need to be specified for the fenestration in order to restrict heat losses.

Advanced double glazing will be specified to limit heat losses and to control solar gains, with the window performance chosen to balance solar gains in winter to help heat the dwelling whilst preventing overheating in summer.

Lighting

It is proposed that only highly energy efficient lighting is installed to the dwelling and to any outdoor lighting.

Modern LED lighting technology means that very high efficiencies are possible. It is proposed that all light fittings should have luminaires with an efficacy of at least 100 lumens per circuit-watt.

Mechanical Services

A well-designed building envelope must be supplemented by appropriate services within the building.

With the decarbonisation of the grid, electric heating and hot water provision is preferred over local fossil fuel solutions. This has the added benefit of not requiring fuel deliveries and no combustion on site, leading to better air quality.

An air source heat pump is feasible for this development. The performance of the recommended unit has been selected to be conservative whilst being reflective of products available on the market. Additionally, the heat pump will also provide hot water heating via a cylinder fed from the heat pump. This will allow space and hot water heating to the dwelling to be provided year-round without requiring an additional 'top up' heating system. The use of an air source heat pump will need to be confirmed by survey before installation.

Renewables

In addition to the air source heat pump, other forms of renewable technologies are explored later in this report.

Overall Performance

The following tables detail how the proposed works can be specified at this stage, incorporating the above principles. Also displayed is how the site would perform in relation to the building regulations and the planning requirements for BCS14.

Proposed Fabric and Services Specification

Table 1 – Baseline Compliance

Showing the specification used to achieve baseline compliance with Part L.

Category	Item	Value/Details
Building Fabric (W/m^2K)	Existing External Walls	0.30
	New Wall	0.18
	Existing Cold Pitched Roof	0.16
	Existing Warm Pitched Roof	0.16
	New Warm Pitched Roof	0.15
	Existing Floor	0.25
	New Floor	0.18
Fenestration (W/m^2K)	Solid Door	1.40
	Windows and Roof Windows	1.40 (g-value 0.63)
Ventilation	Mechanical Ventilation	Intermittent extract fans to wet rooms
Heating	Primary Heating System	Gas Boiler*
	Controls	Programmer, room thermostat and TRVs
	Heat Distribution	Radiators
	Water Heating	From combi boiler
	Secondary Heating System	None
Additional Features	Lighting (lm/W)	75
	SAP Appendix Q	None
	Renewables	None
	Regulation 36/Part G Compliance	125litres/person/day or less

**Gas boiler modelled at this stage for comparison purposes only.*

Table 2 – Additional Measures

Showing the specification used to exceed the minimum standards of Part L.

Category	Item	Value/Details
Building Fabric (W/m^2K)	Existing External Walls	0.26
	Exposed Cold Pitched Roof	0.11
Additional Features	Lighting (lm/W)	100

Table 3 – Residential Energy Efficiency

Unit	Notional Building TER without PV ($kgCO_2/m^2/year$)	Emissions for the Proposed Building with Energy Efficiency Alone ($kgCO_2/m^2/year$)
14 Marlborough Rd	23.37	21.01

Table 4 – Energy Efficiency Measures

Showing how the proposed specification compares to the limiting and notional values for the dwelling.

Element or System	Part L Values (2021)	
	Dwelling Limiting (Conversion)	Proposed (Conversion)
Wall	0.18/0.30W/m^2K	0.18/0.26W/m^2K
Roof	0.16/0.15W/m^2K	0.11/0.15/0.16W/m^2K
Floor	0.25/0.18W/m^2K	0.25/0.18W/m^2K
Windows/Roof Windows	1.40W/m^2K	1.40W/m^2K
Doors	1.40W/m^2K	1.40W/m^2K
Air Permeability	15m^3/hm^2	15m^3/hm^2

Table 5 – Feasibility Matrix of Appropriate Renewables

Showing the considerations in choosing a renewable technology for this site.

Technology	Requirements	Requirements Met?	Appropriate?
Photovoltaic panels	Roof facing east to west (through south)	Yes	Yes
	Little/no or modest overshading	Yes*	
	Flat roof or pitched roof not greater than 45°	Yes	
	Any size development	Yes	
Solar thermal	All requirements as for photovoltaic panels	Yes	Yes
	Hot water tank possible	Yes	
Air source heat pumps	Suitable external wall	Yes	Yes
	Aesthetic considerations	Yes	
	Noise impact	Yes	
	Any size development	Yes	
Ground source heat pumps	External space for horizontal trench or vertical borehole	No	No
	Medium to large sized development	No	
	Archaeology	Unknown	
	Best suited to underfloor heating	No	
Biomass	Space needed for plant, fuel storage and deliveries	No	No
	Medium to large sized development	No	
	Minimal impact on residents (air quality, deliveries)	No	
Combined heat and power	Space need for plant, access and servicing	No	No
	Large sized development (large heat demand)	No	
District heating	Available network	No	No
	Very large sized development (substantial heat demand)	No	

**See the following aerial image demonstrating that the overshading risk is low for the likely location of any solar panels.*

Please refer to Appendices A through G for more in-depth information on these technologies.

Fig. 1 – Aerial Image of the Site – Overshading Risk

Note: As can be seen, there are no obstructions that are likely to create significant overshading to any potential solar panels.

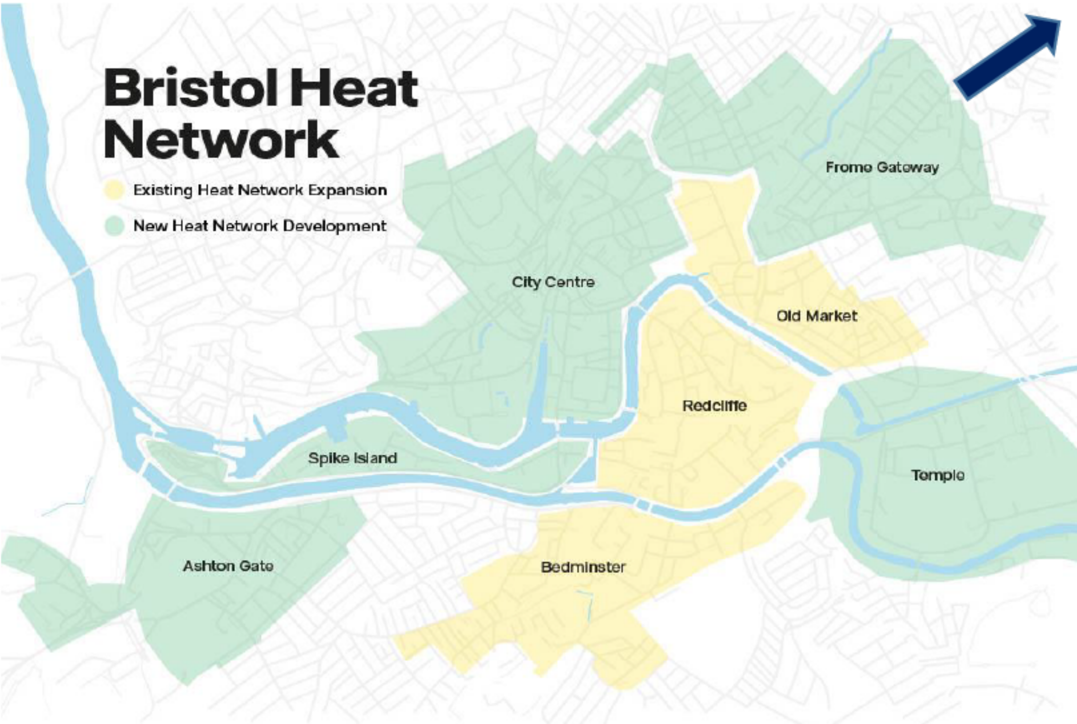
Heat Hierarchy

Table 6 – Following the Heat Hierarchy

Showing how the heat hierarchy, as outlined in BCS14 can be applied to this site.

Stage	Feasible	Notes
1. Connection to existing CHP/CCHP distribution networks	No	No network available
2. Site-wide renewable CHP/CCHP	No	Heat demand not high enough
3. Site-wide gas-fired CHP/CCHP	No	Heat demand not high enough
4. Site-wide renewable community heating/cooling	No	No space for plant
5. Site-wide gas-fired community heating/cooling	No	No space for plant
6. Individual building renewable heating	Yes	Individual system feasible

Fig. 2 – Bristol City Council Heat Networks Map



Note: The blue arrow points in the general direction of the property. It sits about 1.5 miles outside the proposed Frome Gateway. With the proposed heat system that we have in mind for this build should the proposed network extend to cover the area it may be feasible for a connection.

Feasibility of Appropriate Renewables - Conclusion

Due to the location, size and type of development some renewable technologies are not appropriate for this site.

In the future, if a district heating system were to go live in the area, the proposed building could be connected to this network. However, a feasibility study would need to be carried out to confirm the viability of connecting this scheme to such a network.

Solar thermal panels would not provide a sufficient carbon emissions reduction to be suitable.

An air source heat pump is feasible for this development, and due to the limitations on the other renewable sources, this is the best option.

Whilst roof-mounted PV panels are feasible for this site, given the cost of the install of air source heat pump, which already give far more than the 20% reduction, there is no need for any PV to be installed.

Appropriate Solution(s)

Air Source Heat Pump

Table 7 – Proposed Renewables

Category	Item	Value/Details
Heating	Primary Heating System	Air source heat pump
	Controls	Time and temperature zone control
	Heat Distribution	Radiators
	Water Heating	Cylinder fed from air source heat pump

Table 8 – Installed Renewables Capacity

Item	Value/Details
Renewable Electricity – Enter the total installed capacity (kW)	0.00kWp
Renewable Electricity – Enter the estimated annual yield (kW) from renewable measures generating electricity (where available apply recognised standard methodologies such as the Microgeneration Certification Scheme (MCS) methodology for PV)	0.00kW/year
Renewable Heat – Enter the total installed capacity	6kW
Renewable Heat – Enter the estimated annual yield (kWh) from renewable measures generating heat	Heat pump estimated to use 3,306kWh/year for heating and hot water

Table 9 – Summary Table for Renewables

No District Heat Connection	Regulated Energy Demand (MWh/yr)	Regulated CO_2 Emissions (tonnes/yr)	CO_2 Saved (tonnes/yr)	CO_2 Reduction (%)
Baseline - Part L TER	10.74	2.23		
Baseline - Part L TER Without PV	10.74	2.23		
Proposed scheme after energy efficiency measures	9.65	2.01	0.23	10.10
Residual emissions Proposed scheme after energy efficiency measures and CHP (if using)	9.65	2.01	0.00	0.00
Proposed scheme after on-site renewables	3.52	0.52	1.49	74.11
Total CO_2 reduction beyond Part L TER			1.71	76.72

For further details please refer to the SAP Reports.

Table 10 – Detail

Plot	Baseline Energy Demand (kWh pa)	Baseline CO_2 (kg pa)	Additional Measures Energy Demand (kWh pa)	Additional Measures CO_2 (kg pa)	Renewables Energy Demand (kWh pa)	Renewables CO_2 (kg pa)
Flat 1	10,738.11	2,231.84	9,653.12	2,006.46	3,522.48	519.52

Appendix A – Photovoltaic Panels

What are Photovoltaic Panels?

Photovoltaic Panels (PV) panels convert the energy in light received from the Sun into electricity. There are two types of system – grid connected systems are the most common and allow electricity to be drawn from the national grid during times when the panels are not generating enough electricity to provide all the power needs. This setup also allows any surplus electricity to be sold back to the grid. Conversely, standalone systems are not connected to the grid and so require supplementing with other power generating systems or batteries to ensure that the supply of electricity is not interrupted.

Space Requirements

PV Panels are composed of a series of small solar cells that are connected together. They come in a variety of shapes, sized and outputs and ideally will be installed on an inclined south-facing roof to maximise the power generated. Larger arrays will result in more power being generated, up to the limits of available roof space. If space is limited, solar tiles can be installed as these can fit more capacity into the same area. However, these are more expensive than traditional panel installations.

Installation Costs, Funding, Maintenance and Payback

The average cost for a solar panel installation for a small-scale building is approximately £5,000-£9,000, although this is highly dependent on the size of array being installed. Planning permission is not usually required unless the panels are to be installed on a listed building or the property is situated in a conservation area.

The photovoltaic array can be expected to last for up to 25 years, depending on the manufacturer.

On January 1st 2020, a new government incentive scheme was introduced, known as the Smart Export Guarantee (SEG). For those installing small scale renewable technologies, with a maximum capacity of 5MW, the SEG will pay for each unit of electricity fed into the National Grid. It is anticipated that payback for a PV system could be achieved in approximately 12 years.

Advantages of Photovoltaic Panels

- Electricity bills reduced
- Source of renewable energy
- Reduced carbon footprint
- Low maintenance

Disadvantages of Photovoltaic Panels

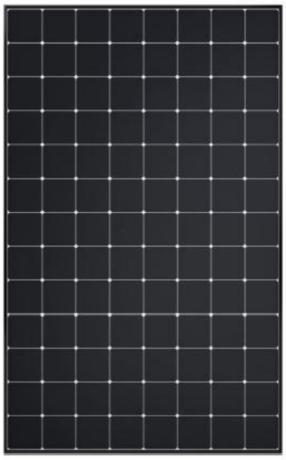
- Relatively high upfront cost
- Energy generation varies with the average annual amount of radiation received
- Power output highly weather dependent
- No electricity produced at night
- Requires a lot of roof space for an effective array.

Solar Panel Example

SUNPOWER | MAXEON

Fundamentally different, and better

Back Contact | White Backsheet Black Frame | Residential



MAXEON 3

POWER RANGE: 390-400 W | EFFICIENCY: Up to 22.6%

Part of the record-setting SunPower Maxeon product line, the SunPower Maxeon 3 solar panel offers homeowners the highest efficiency available in the market today, maximising long-term energy production, as well as savings potential per available space. [1]

SunPower Maxeon panels are world-renowned for their energy production and savings advantages that combine unmatched efficiency and reliability with an industry-leading warranty and an estimated 40-year useful life.[2,3,4]

SunPower Maxeon Solar Cell Technology

- Proven technology across 3.5 billion cells shipped
- Most efficient cell in commercial solar [1]
- Only solar cell with a solid-metal foundation, providing patented protection from breakage and corrosion

Maximum Lifetime Energy and Savings

The SunPower Maxeon 3 solar panel is designed to deliver 35% more energy in the same space over 25 years in real-world conditions such as partial shade and high temperatures. [5,6,7]

A Better Product. A Better Warranty.

The 25-year SunPower Complete Confidence Panel Warranty is backed by testing and field data from more than 30 million SunPower Maxeon panels deployed—and a demonstrated warranty return rate of .005%. [8]

25-yr SunPower Complete Confidence

Year 1 Minimum Warranted Power Output	98.0%
Maximum Annual Degradation	0.25%
Year 25 Warranted Power Output	92.0%

Leadership in Sustainable Manufacturing

SunPower Maxeon panels—and the facilities in which they are produced—raise the bar for environmental and social responsibility. Included below are highlights of the certifications and recognition received by some of our products and manufacturing sites.

Declare. | NSF Landfill-Free Facility NSF P445 | AWARD 2019

sunpower.maxeon.com

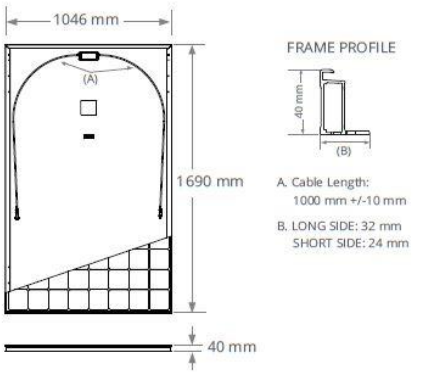
MAXEON 3 POWER: 390-400 W | EFFICIENCY: Up to 22.6%

Electrical Data			
	SPR-MAX3-400	SPR-MAX3-395	SPR-MAX3-390
Nominal Power (Pnom) [9]	400 W	395 W	390 W
Power Tolerance	+5/0%	+5/0%	+5/0%
Panel Efficiency	22.6%	22.3%	22.1%
Rated Voltage (Vmpp)	65.8 V	65.1 V	64.5 V
Rated Current (Impp)	6.08 A	6.07 A	6.05 A
Open-Circuit Voltage (Voc) (+/-3%)	75.6 V	75.4 V	75.3 V
Short-Circuit Current (Isc) (+/-3%)	6.58 A	6.56 A	6.55 A
Max. System Voltage	1000 V IEC		
Maximum Series Fuse	20 A		
Power Temp Coef.	−0.27% / °C		
Voltage Temp Coef.	−0.236% mV / °C		
Current Temp Coef.	0.060% mA / °C		

Tests And Certifications	
Standard Tests [10]	IEC 61215, IEC 61730
Quality Management Certs	ISO 9001:2015, ISO 14001:2015
Ammonia Test	IEC 62716
Desert Test	IEC 60068-2-68, MIL-STD-810G
Salt Spray Test	IEC 61701 (maximum severity)
PID Test	1000 V: IEC 62804, PVEL 600 hr duration
Available Listings	TUV

Sustainability Tests and Certifications	
IFLI Declare Label	First solar panel labeled for ingredient transparency and LBC-compliance.[12]
Cradle to Cradle Certified™ Bronze	First solar panel line certified for material health, water stewardship, material reutilization, renewable energy & carbon management, and social fairness.[13]
Green Building Certification Contribution	Panels can contribute additional points toward LEED and BREEAM certifications.[14]
EHS Compliance	RoHS, OHSAS 18001:2007, lead free, REACH SVHC-163

Operating Condition And Mechanical Data	
Temperature	−40°C to +85°C
Impact Resistance	25 mm diameter hail at 23 m/s
Solar Cells	104 Monocrystalline Maxeon Gen III
Tempered Glass	High-transmission tempered anti-reflective
Junction Box	IP-68, Stäubli (MC4), 3 bypass diodes
Weight	19 kg
Max. Load [11]	Wind: 2400 Pa, 244 kg/m² front & back Snow: 5400 Pa, 550 kg/m² front
Frame	Class 1 black anodized (highest AAMA rating)



Please read the safety and installation guide.

1 Based on datasheet review of websites of top 20 manufacturers per IHS, as of Jan, 2020.
2 Jordan, et. al. Robust PV Degradation Methodology and Application. PVSC 2018.
3 Based on Oct. 2019 review of warranties on manufacturer websites for top 20 manufacturers per IHS 2018.
4 "SunPower Module 40-Year Useful Life," SunPower whitepaper. 2013.
5 SunPower 370 W, 22.7% efficient, compared to a Conventional Panel on same-sized arrays (310 W mono PERC, 19% efficient, approx. 1.64 m²)
6 PV Evolution Labs "SunPower Shading Study," 2013. Compared to a conventional front contact panel.
7 Based on temperature coefficients provided in manufacturer datasheets 2020.
8 SunPower panels are less than 50 dppm, or 0.005%, on over 15 million panels shipped - Source: SunPower White Paper, 2019.
9 Standard Test Conditions (1000 W/m² irradiance, AM 1.5, 25° C). NREL calibration Standard: SOMS current, LACCS FF and Voltage.
10 Class C fire rating per IEC 61730.
11 Safety factor 1.5 included.
12 SunPower Maxeon DC panels first received the International Living Future Institute Declare Label in 2016.
13 SunPower Maxeon DC panels are Cradle to Cradle Certified™ Bronze - www.c2ccertified.org/products/scorecard/e-series_x-series_solar_panels_-_sunpower_corporation. Cradle to Cradle Certified™ Bronze. Cradle to Cradle Certified™ is a certification mark licensed by the Cradle to Cradle Products Innovation Institute.
14 Maxeon panels can contribute to LEED Materials and Resources categories and BREEAM certification.

Designed in U.S.A. by SunPower Corporation
Made in Philippines (Cells)
Assembled in Mexico (Module)

Specifications included in this datasheet are subject to change without notice.

SUNPOWER
FROM MAXEON SOLAR TECHNOLOGIES

sunpower.maxeon.com

536423 REV B / A4_EN
Publication Date: July 2020

Appendix B – Solar Thermal Panels

What is Solar Thermal Energy?

A solar thermal system uses energy from the Sun to heat water which is then stores in a hot water cylinder.

Space Requirements

For a small scale solar thermal setup, it is suggested that approximately five square meters of south facing space will be required, to ensure that as much solar energy as possible can be collected. A sloping roof is not required as the panels can be fitted to a frame mounted on a flat roof or even hung from a wall.

Before installing a solar thermal system, it is important to check if your current setup is suitable – solar thermal systems require a hot water cylinder to store the heated water and are therefore not compatible with combination boilers or direct acting water heaters. If the cylinder present prior to the installation of the solar thermal system is not a solar cylinder, it will be necessary to either replace the cylinder with one which has a solar heating coil fitted or to add an extra cylinder with a solar coil to ensure that the system works correctly.

Installation Costs, Funding, Maintenance and Payback

The initial cost of installing a typical small scale solar thermal system is generally between £5,000 and £9,000. There are currently no financial schemes available for solar thermal panels.

Very little maintenance is usually required after the system is installed, although it is important to have the system inspected every three to seven years by a qualified solar panel expert.

The payback costs for solar panels depend greatly on the installation costs. For example, a system costing between £5,000 and £7,000 to install has a typical payback time between 13 and 17 years.

Planning Requirements

Planning permission is generally not required for the installation of a solar thermal system. However, restrictions may apply if the building is listed or sited withing a conservation area – it is advisable to check with the local council prior to installation.

Advantages

- Clean and efficient water heating
- Easy to maintain
- Quiet
- Low carbon footprint

Disadvantages

- High initial cost
- Effectiveness depends on the number of hours of sunshine your area gets during the day
- The system is limited to only heating water – no electricity is produced
- Only useful if there is meaningful hot water demand

Appendix C – Air Source Heat Pumps

What are Air Source Heat Pumps?

Air source heat pumps (ASHPs) extract thermal energy from outside air (using the principles of vapor compression refrigeration), which can then be used to heat the building as well as to provide hot water. Heat pumps can also be run in reverse, cooling the building and transferring the excess heat to the outside.

There are two types of air source heat pump systems:

1. **Air to air** systems transfer the warmed air throughout the building using fans
2. **Air to water** systems transfer heat to water, which is then distributed via plumbing similar to that used in a conventional heating system with a boiler

Air source heat pumps operate at lower temperatures than traditional gas boilers. This means that these systems can be utilised more effectively with an underfloor heating setup compared to using radiators, as with underfloor heating the warmth is distributed more evenly and thus more efficiently. It is vital that the building fabric be well insulated if the benefits of an air source heat pump are to be fully utilised.

Space Requirements

An area on the exterior of the building, such as on a wall or roof, will be required for the external unit. This ideally should be in a warmer location which not only has enough space for the unit but is also clear of obstructions to allow air to flow freely.

Additionally, space will be required for the internal unit. Typically, these are no larger than a standard hot water cylinder or boiler unit, depending on the exact setup used. However, with many setups a separate hot water cylinder, along with the space for this, is also required.

Installation Costs, Funding, Maintenance and Payback

The cost of purchasing and installing an air source heat pump system is generally between £3,000 and £11,000, depending on the size and complexity of the setup. Additional costs may be incurred if your property is particularly large. However, it may be possible to obtain payments from the Government's Renewable Heat Incentive (RHI), which will offset some of the costs incurred with installing the heat pump.

Air source heat pumps can be expected to last for up to 20 years as long as they are inspected every three to five years by a qualified technician. A typical payback period for ASHPs is around 12 years, once RHI is taken into account.

Planning

It is advisable to consult your local planning authority prior to purchasing the heat pump to establish whether there are any restrictions as to the positioning of the external unit.

Advantages

- Lower fuel bills
- Can provide heating in winter and cooling in the summer as well as hot water year-round
- Low maintenance
- Low carbon footprint

Disadvantages

- Works more efficiently with underfloor heating, or larger radiators
- The outdoor unit produces noise so careful siting is required
- Less efficient in winter due to the need to extract heat from colder air, resulting in lower Coefficient of Performance (COP) values.

Air Source Heat Pump Example

Heating | **Product Information**

MITSUBISHI ELECTRIC

PUZ-WM85VAA(-BS)

Ecodan R32

Monobloc Air Source Heat Pump

R32

Key Features:	Key Benefits:
■ A+++ high efficiency system	■ Ultra low running cost
■ Ultra quiet noise levels	■ Flexible product placement
■ Maintains full heating capacity at low temperatures	■ Confident and quick product selection
■ Zero carbon solution	■ Help to tackle the climate crisis
■ MELCloud enabled	■ Remote control, monitoring, maintenance and technical support

MELCloud

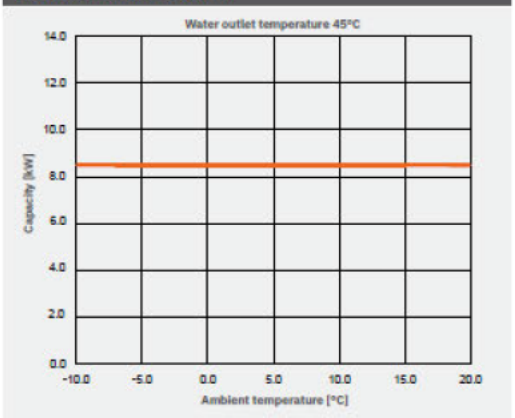
ecodan.co.uk

Heating | Product Information

PUZ-WM85VAA(-BS)
Ecodan R32
Monobloc Air Source Heat Pump

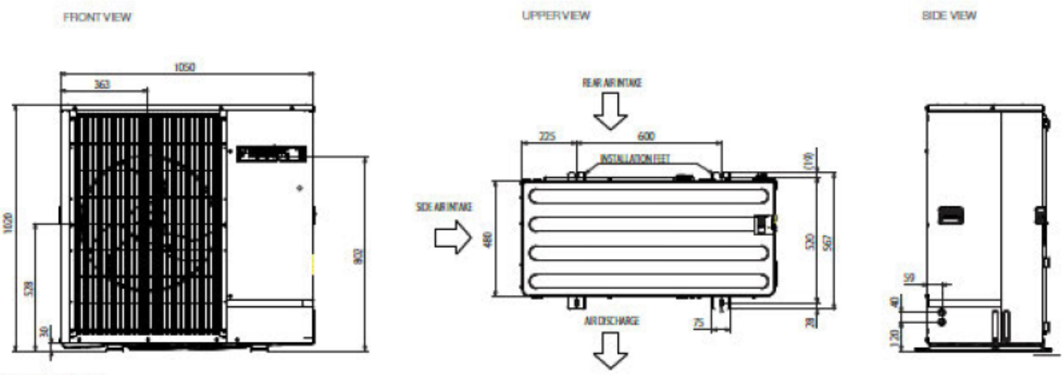
OUTDOOR UNIT		PUZ-WM85VAA(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	139%
	SCOP (MCS)	3.48
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+++
	η_s	193%
	SCOP (MCS)	4.84
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	145%
HEATING*2 (A-7/W35)	Capacity (kW)	8.5
	Power Input (kW)	3.27
	COP	2.60
OPERATING AMBIENT TEMPERATURE (°C DB)		-20 ~ +35
SOUND DATA*3	Pressure Level at 1m (dBA)	45
	Power Level (dBA)*4	58
WATER DATA	Pipework Size (mm)	28
	Flow Rate (l/min)	24
	Water Pressure Drop (kPa)	15.0
DIMENSIONS (mm)	Width	1050
	Depth	480
	Height	1020
WEIGHT (kg)		98
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz
	Phase	Single
	Nominal Running Current [MAX] (A)*5	9.1 [22]
	Fuse Rating - MCB Sizes (A)*6	25
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	2.2/ 1.49

NOMINAL HEATING CAPACITY



Notes:
*1 Combination with E*PT20X Cylinder
*2 Under normal heating conditions at outdoor temp: -7°CDB / -8°CWB, outlet water temp 35°C, inlet water temp 30°C.
*3 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 55°C, inlet water temp 47°C as tested to BS EN14511.
*4 Sound power level tested to BS EN12102.
*5 Under nominal heating conditions at outdoor temp: 7°C, outlet water temp: 35°C.
*6 MCB Sizes BS EN60898-2 & BS EN60947-2.
η_s is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

PUZ-WM85VAA(-BS) DIMENSIONS



All dimensions (mm)

MITSUBISHI ELECTRIC
Changes for the Better
Telephone: 01707 282880
email: heating@meuk.mee.com
heating.mitsubishielectric.co.uk

@meuk_les @green_gateway | Mitsubishi Electric Living Environmental Systems UK | Mitsubishi Electric Cooling and Heating UK | mitsubishielectricuk_les | Mitsubishi Electric Living Environmental Systems UK | BLOG thehub.mitsubishielectric.co.uk

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Note: Refer to 'Installation Manual' and 'Instruction Book' for further 'Technical Information'. The fuse rating is for guidance only and please refer to the relevant databook for detailed specification. It is the responsibility of a qualified electrician/electrical engineer to select the correct cable size and fuse rating based on current regulation and site specific conditions. Mitsubishi Electric's air conditioning equipment and heat pump systems contain a fluorinated greenhouse gas, R410A (GWP:2088), R32 (GWP:675), R407C (GWP:1774), R134a (GWP:1430), R513A (GWP:631), R454B (GWP:466), R1234ze (GWP:7) or R1234yf (GWP:4). *These GWP values are based on Regulation (EU) No 517/2014 from IPCC 4th edition. In case of Regulation (EU) No.626/2011 from IPCC 3rd edition, these are as follows. R410A (GWP:1975), R32 (GWP:550), R407C (GWP:1650) or R134a (GWP:1300).

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Appendix D – Ground Source Heat Pumps

What are Ground Source Heat Pumps?

Ground source heat pumps (GSHPs) use pipes, buried in available land close to the building, to extract heat from the ground. Water and antifreeze are circulated around the pipes absorbing heat, which is the transferred through a heat exchanger in the heat pump into the building. From this point, the heat can be used to provide space or hot water heating, or the system can be run in reverse to provide cooling.

Ground source heat pumps operate at lower temperatures than traditional gas boilers. This means that these systems can be utilised more efficiently with an underfloor heating setup than with radiators. It is particularly vital that the building be well insulated to fully take advantage of the benefits of a ground source heat pump.

Space Requirements

There are two types of ground source heat pump systems:

1. **Horizontal** systems, which require an area of approximately 700m^2
2. **Vertical** systems, which have a borehole approximately a quarter of a metre across and up to 100m deep.

Larger sites will require either a larger area or more boreholes. Whichever system is chosen, suitable access must be available for the machinery required to install the pipework, especially in the case of the drill rig required for the vertical systems.

Space must also be available for the internal unit. These are typically larger than a standard gas boiler, approximately the size of a domestic hot water cylinder.

Installation Costs, Funding, Maintenance and Payback

Installing ground source heat pumps can cost between £10,000 and £18,000. The horizontal system is often cheaper as the expensive drill rig required to drill the borehole is unnecessary.

It may be possible to obtain payments from the Government's Renewable Heat Incentive (RHI), which will help to offset some of the costs involved with installing the heat pump. Additionally, the heat pump, if inspected regularly by a qualified servicer, can be expected to last for up to twenty years.

With low running costs and possible income from the RHI, the payback period can typically be between 8 and 12 years.

Planning Requirements

Ground source heat pumps are generally permitted, but some restrictions apply, such as with listed buildings. Consulting your local authority prior to installation is recommended.

Advantages

- Lower fuel bills, especially if used to replace direct electric heating
- Can provide both space and hot water heating
- Can provide heating in winter and cooling in summer as well as hot water year-round
- Lower carbon footprint
- Low maintenance
- More efficient in winter than air source heat pumps due to ground temperatures remaining more constant throughout the year

Disadvantages

- More expensive to install than air source heat pumps
- Suitable land mist be available for the pipework or boreholes
- The building must be very well insulated
- Works most efficiently with underfloor heating or warm air distribution

Appendix E – Biomass

What is Biomass?

Biomass is any fuel obtained from natural or organic material, such as manure, forest debris or agricultural or horticultural waste. The most common biomass energy source is wood in the form of pellets, wood chips or logs. Biomass boilers can be used as a replacement for a fossil fuel-based heat source, and are best suited to medium to large scale sites.

Space Requirements

Typically, biomass boilers are contained in a single plant room serving the whole site. This room needs to be big enough for the boiler or boilers themselves, along with water tanks and space for fuel storage.

Installation Costs, Funding, Maintenance and Payback

The cost of a biomass boiler depends on a number of factors, including the type of boiler used, the fuel type and storage size. For example, the cost, including installation, of an automatically-fed pellet boiler can be as much as £20,000. It is important to note that biomass boilers are also eligible for the Government Renewable Heat Incentive (RHI) scheme, which provides payments to those using renewable heating systems. Therefore, despite the high initial cost, biomass boilers can have relatively short payback times of around 5-7 years.

Biomass boilers should be serviced every 12 months to ensure continued efficiency and to prevent any breakdowns.

Planning

There may be restrictions on the installation of biomass systems, due to concerns over local pollution and disruption to residents caused by deliveries.

Advantages

- Sustainable energy source
- Reduces dependence on fossil fuels
- Carbon-neutral – the carbon produced is absorbed by plants which can then be used as future biomass fuel
- Reduces waste sent to landfill
- Abundant availability of fuel

Disadvantages

- The burning of biomass fuels produces various gases that can contribute to local air pollution
- Space is required on-site for a plant room and fuel storage, as well as a designated fuel delivery area
- Constructing and operating biomass energy plants are often more expensive than more traditional power plants

Appendix F – Combined Heat and Power

What is Combined Heat and Power?

Combined Heat and Power (CHP), sometimes referred to as cogeneration, is a setup in which heat and power are generated simultaneously.

Energy which is lost at various steps in producing electricity in a conventional power plant can be captured and used to provide warmth. For example, water which has condensed from the steam used to turn the generating turbine is typically cooled in large cooling towers, with all the energy lost to the air. In a CHP plant, this 'waste' heat is instead used to produce hot water, hot air or steam, which can then be distributed to heat local buildings.

Space Requirements

Significant space is required for the power plant itself, as well as the additional space required for the recovery of the otherwise wasted heat. Additionally, to use this energy effectively, a large pipe network is needed to distribute the heat around the local area.

Installation Costs, Funding, Maintenance and Payback

The costs involved with setting up a CHP system, especially if the power plant is being constructed along with it rather than converted, are relatively high. As a result of this, these schemes tend to be large-scale long-term projects.

The network must be kept well maintained to avoid loss of service and to ensure continued operation. However, a large-scale network can heat a wide area more efficiently than with individual building heating systems, providing good long-term return on investments.

Advantages

- The CHP process can be applied to power plants that use either renewable or fossil fuels as well as those which use a combination of the two
- Emissions are generally lower than other electricity and heat producing systems
- A variety of energy consumers can benefit from the installation of a CHP plant, including hospitals, schools and industrial sites

Disadvantages

- CHP plants need to be local to their users to ensure as little energy is lost in the transmission as possible.
- The technology needed is expensive and more complex. Maintenance costs can also be greater
- Considerable amount of space is required for a full-size CHP setup, making it suitable only for larger sites

Appendix G – District Heating

What is District Heating?

Instead of relying on one boiler for each unit on site, district heating utilises hot water or steam from a single communal heat source and distributes that energy to a variety of consumers through a network of insulated pipes. This network can be as large as desired, allowing entire communities to benefit, as well as reducing the need for additional energy to be produced specifically for heating buildings in the local area.

In the individual property or building, a heat interface unit (HIU) gives the consumer control over the hot water they use in a similar manner to that provided by a traditional boiler.

Space Requirements

An energy centre or large plant room would be required for this type of system. Depending on the scale of the heat network, pipework may need to be laid underground to distribute the hot water across the site or to the local area.

Installation Costs, Funding, Maintenance and Payback

The initial cost of setting up district heating, including the plant and infrastructure needed to deliver the heat, is relatively high and so these large-scale schemes tend to be a long-term investment.

Regular maintenance is essential to ensure continued efficiency and to prevent any breakdowns.

Advantages

- More energy efficient as energy which is otherwise wasted can be used
- Lower carbon emissions
- Has the potential to reduce heating costs

Disadvantages

- If the main fuel source experiences problems, whole areas could potentially be without heating or hot water
- Can in some cases be more expensive than traditional heating
- A large network is required to gain full benefit – it is only suitable for use on very large sites or where there is a network already present