Energy Statement

Frognal Garages

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1.0 Introduction

1.1 Executive Summary

MES have been commissioned to provide an energy statement in order to address the requirements of Camden Council in relation to the proposed development at Frognal Garages, Frognal Lane. The purpose of this energy y statement is to provide an overview of the predicted energy requirements and associated carbon dioxide emissions for the proposed development.

The applicable planning policies this report will address are detailed in the Camden Local Plan 2017 and the London Plan 2021. The relevant policies dovetail, with policies CC1 & CC2 from the Local Plan covering the same ground as the London Plan 2021 policies SI2 & SI3. Camden Local Plan policy CC2 will be addressed in full in an accompanying Sustainability Statement, so this report concentrates on how the development addresses CC1.

The energy and carbon reductions required by both the Camden Local Plan policy CC1 and London Plan policy SI2 have been achieved by following the energy hierarchy, which includes:

- Calculation of estimated baseline energy consumption & CO_2 emissions using sample SAP10.2 calculations
- Implementation of the energy hierarchy (be lean, be clean, be green)
- Assessment of the viability of connection to existing heat networks and/or the use of CHP
- Calculation of estimated energy consumption & CO_2 emissions at each stage of energy hierarchy
- Calculation of estimated final energy consumption & CO_2 emissions
- Calculation of reduction in emissions achieved at each stage

In line with the favoured approach of Camden Council and the GLA we have calculated the total energy requirement for the development using Part L 2021 compliant SAP10.2 calculations for a representative sample of the apartments. The Part L 2021 carbon factors have then been applied to the modelled energy consumption used to calculate the resulting CO_2 emissions from the development. This is in line with the guidance contained in paragraph 9.2.6 of the London Plan 2021. For the proposed development this has been achieved by the use of;

- An improved building fabric over the Part L 2021 baseline requirements.
- Reducing heat loss through uncontrolled ventilation (air leakage)
- The use of MVHR units to reduce heat loss via controlled ventilation
- The use of ASHPs as the main heating source (space & DHW heating)

Table 1.1, below, show the modelled performance based on the SAP calculations for each stage of the Energy Hierarchy. Further details can be found in Section 3 and the appendices to this report.

Table 1.1: Total reduction in energy use and carbon emissions

	Regulated Energy Consumption (kWh per annum)	Regulated CO_2 Emissions (Tonnes per annum)	Regulated CO_2 savings	
			(Tonnes per annum)	(%)
Baseline	29,728	6.6		
Be Lean	27,438	6.0	0.6	**10%**
Be Clean	27,438	6.0	0.0	**0%**
Be Green	14,705	2.1	3.9	**59%**
Cumulative on site savings	**15,023**		**4.5**	**68%**

As can be seen the proposed development meets the Camden Local Plan CC1 and London Plan policy SI2 requirements. Overall, the development needs to achieve at least a 19% reduction in carbon emissions. As can be seen from Table 1.1 the proposed development achieves a total reduction in carbon emissions across the

development of 68%, so is in compliance with the CC1 and SI2 requirements. The improvement at the 'Be Green' stage is also the amount of CO_2 reduction achieved from the use of on-site renewables – so the development also achieves the Camden requirement of 20% CO_2 reduction from on-site renewables, as the 'Be Green' reduction is 59%.

As required by the June 2022 updated guidance for the production of energy statements, the Energy Use Intensity (EUI), space heating demand and FEES performance have been calculated using the same SAP10.2 and SBEM models as the energy and CO_2 consumption. This information can be found in Table 1.2 below.

It should be noted that the targets set for this metric are based on modelling using the PassivHaus Planning Package. This uses a different set of modelling conventions, as well as produces a different set of performance figure even for the same building – particularly when it comes to the unregulated energy. As such it is not surprising that the modelled figures using SAP do not achieve the targets, as the development has been modelled using SAP in order to comply with the carbon calculation requirements of the GLA. It is also worth noting that the unregulated energy alone comes to 23.5kWh/m^2/year, which makes the EUI targets seem extremely difficult, if not impossible, to achieve when using SAP10.2 as the modelling approach.

Table 1.2: EUI, space heating demand & FEES

Building Type	Energy Use Intensity (kWh/m^2/year, excluding renewable energy)	Space Heating Demand (kWh/m^2/year, excluding renewable energy)	Design Fabric Energy Efficiency (FEES)
Residential	52.3	11.0	33.97
Target	35.0	15.0	35.49

1.2 Planning Policy

The main policy in London Borough of Camden's Local Plan that relates to energy and carbon dioxide emissions is CC1. This has been reproduced below.

Policy CC1 Climate change mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
d. support and encourage sensitive energy efficiency improvements to existing buildings;
e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and

i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

The energy hierarchy

8.6 The Council's Sustainability Plan 'Green Action for Change' commits the Council to seek low and where possible zero carbon buildings. New developments in Camden will be expected to be designed to minimise energy use and CO2 emissions in operation through the application of the energy hierarchy. It is understood that some sustainable design measures may be challenging for listed buildings and some conservation areas and we would advise developers to engage early with the Council to develop innovative solutions.

8.7 The energy hierarchy is a sequence of steps that minimise the energy consumption of a building. Buildings designed in line with the energy hierarchy prioritise lower cost passive design measures, such as improved fabric performance over higher cost active systems such as renewable energy technologies. The following diagram shows a simplified schematic of the energy hierarchy, which is explained further in supplementary planning document Camden Planning Guidance on sustainability.

8.8 All developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floorspace will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be required to demonstrate a 19% CO2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

The combination of Policy CC1 and the above extract from London Borough of Camden's Planning Guidance Energy Efficiency & Adaption gives a requirement that the development reduce its carbon emissions by a minimum of 19%. It is encouraged that developments go beyond this, so this report will demonstrate a larger improvement than this. This improvement does not have to be down to renewable technologies, but can be the result of any combination of fabric improvements, efficient building services, and decentralised energy or LZC technologies. It also requires that development of 5+ units achieve a 20% reduction in CO_2 from onsite renewables.

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve “excellent” in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve “excellent” in BREEAM assessments and encouraging zero carbon in new development from 2019.

The London Plan (adopted March 2021)

Policy SI 2 Minimising greenhouse gas emissions

A Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) be lean: use less energy and manage demand during operation
2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
4) be seen: monitor, verify and report on energy performance.

B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1) through a cash in lieu contribution to the borough’s carbon offset fund, or

2) off-site provided that an alternative proposal is identified and delivery is certain.

D Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

F Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Policy SI 3 Energy infrastructure

A Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:

1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
2) heat loads from existing buildings that can be connected to future phases of a heat network
3) major heat supply plant including opportunities to utilise heat from energy from waste plants
4) secondary heat sources, including both environmental and waste heat
5) opportunities for low and ambient temperature heat networks
6) possible land for energy centres and/or energy storage
7) possible heating and cooling network routes
8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works
9) infrastructure and land requirements for electricity and gas supplies
10) implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11) opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C Development Plans should:

1) identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
2) identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

D Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
    a) connect to local existing or planned heat networks
    b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
    c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
    d) use ultra-low NOx gas boilers

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality
3) where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

E) Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

Policy SI 4 Managing heat risk

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2) minimise internal heat generation through energy efficient design
3) manage the heat within the building through exposed internal thermal mass and high ceilings
4) provide passive ventilation
5) provide mechanical ventilation
6) provide active cooling systems.

Policy SI 5 Water Infrastructure

A In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.

B Development Plans should promote improvement to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.

C Development proposals should;
1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)
2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)
3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help achieve lower water consumption rates and maximise future proofing.

D In terms of water quality, Development Plans should;
1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans
2) support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.

E Development proposals should:
1) seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided.
2) take action to minimise the potential for misconnections between foul and surface water networks.

F Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage.

1.3 Part L 2021

A new version of Part L of the Building Regulations was introduced on 15th June 2022. Following this the GLA have updated their guidance for the production of energy statements provided via their document 'Energy Assessment Guidance'[1].

This clarifies that the same carbon reductions due to energy efficiency measure and overall carbon reductions continue to apply, with these now being required over the 2021 Part L.

It also requires that residential developments report the Fabric Energy Efficiency Standard (FEES) for the development as a whole. It should also be shown how much improvement the proposed specification has made over the Target FEES.

It also requires that the Energy Use Intensity and the space heating demand of the development be provided. Paragraph 7.13 (page 20) states that applications should aim to achieve the values in Table 4 of the Energy Assessment Guidance document – this is reproduced below;

Building Type	Energy Use Intensity (kWh/m²/year)	Space Heating (kWh/m²/year)
Residential	35	15
School	65	15
Office	55	15
Hotel	55	15
All other non-residential	55	15

Finally, it requires that an assessment is made of the cost to occupants and show what is proposed to protect the consumer from high energy prices.

[1] https://www.london.gov.uk/sites/default/files/gla_energy_assessment_guidance_june_2022_0.pdf

2.0 Description of the Development

2.1 Location

The proposed development is located on Frognal Lane, Hampstead. The surrounding area is comprised of a mix of residential and commercial buildings of varying heights and scales. The site location can be found in Figure 2.1, below.

Figure 2.1: Aerial photograph showing site location

2.2 Details of the Development

Application for full planning permission for the demolition of the existing garages and redevelopment of the site to provide a building of three storeys in height, plus lower ground, to include seven residential units (Use Class C3), with excavation of basement, associated amenity space, two replacement garages, front and rear landscaping and associated works.

Floor plans and elevations showing the proposed development can be found in Appendix 1 to this report.

3.0 Energy Statement

3.1 The Energy Hierarchy

In order to address energy efficiency the design team have adopted the energy hierarchy. The energy hierarchy is generally accepted as the most effective way of reducing a buildings' carbon emissions.

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy
4. Be seen: monitor, verify and report on energy performance

Development proposals should:

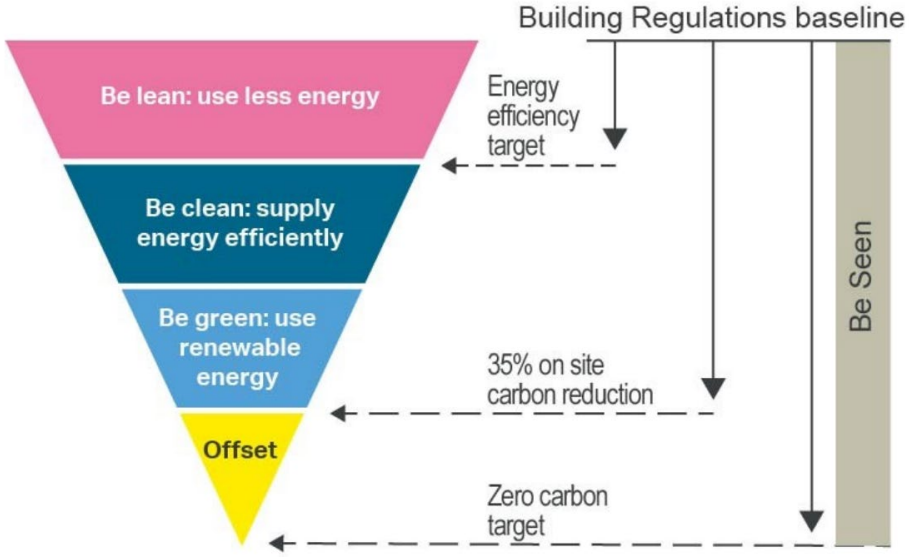

Figure 3.1: The Energy Hierarchy

- ***Reducing energy demand***

The first step in the process of reducing the overall energy used and CO_2 produced by the building is to minimise the energy required to heat it. A well-insulated building envelope and passive design will reduce the energy requirement for heating and ventilating the building.

- ***Energy efficient systems***

The second step is to specify services and controls, lighting and appliances that are energy efficient and which result in further reduction in energy requirements.

- ***Making use of Low or zero-carbon (LZC) technologies***

When the energy demand has been reduced by implementing the processes of improving the fabric and energy efficiency, then LZC technologies can be employed to reduce the environmental impact of the remaining energy consumption.

- ***Monitoring and reporting***

Ensure comprehensive monitoring and reporting of energy demand and carbon emissions. Major developments are required to undertake this process for at least five years.

3.2 Calculating Baseline Energy Demand

The first step is to calculate a Building Regulations Part L1 2021 compliant specification in order to establish baseline emissions for the development. Calculated energy data using the government's approved methodology,

SAP10.2, has been used to establish baseline energy requirements which comply with the 2021 edition of Part L standards. To calculate the associated carbon emissions SAP10.2 carbon factors have been used, as per Part L 2021.

The baseline emissions and energy consumption figures for the dwellings have been taken from the Part L1 TER calculations as generated from the SAP10.2 modelling. The results are shown in Table 3.1 below. Full details (SAP worksheets) can be found in Appendix 2.

Table 3.1:'Baseline' energy use and carbon emissions				
	Regulated Energy Consumption (kWh per annum)	Regulated CO_2 Emissions (Tonnes per annum)	Regulated CO_2 savings	
			(Tonnes per annum)	(%)
Baseline	29,728	6.6		

The strategic aim is to reduce carbon emissions overall, so that while planning decisions and monitoring requirements will be underpinned by the targets expressed above, the requirement for energy assessments to include separate details of unregulated emissions is to recognise explicitly the additional contribution that can be made through use of efficient equipment, building controls and good management practices, including green leases. Unregulated emissions are, therefore, considered (particularly as part of the EUI calculation) but are not taken into account when calculating percentage improvements or any carbon offset payment.

The unregulated energy consumption for the proposed development has been calculated, for the residential units, by using information developed by the Good Homes Alliance in their Building Standards Compared[2] report. SAP has not kept up with modern standards for unregulated energy, and to deliver a more realistic calculation the GHA have derived data from PHPP (Passivhaus Planning Package) and provided that in the above report. This approach, for the dwelling mix on the proposed development, gives us a total of 11,989kWh/year for the residential units. Applying the Part L 2021 mains electricity carbon factor (0.136kg/kWh gives a total of 1.63tonnes/year. This accounts for all unregulated energy used for cooking, all appliances and any small power in the development.

3.3 'Be Lean' – Building Fabric Improvements

The first step of the energy hierarchy looks at reducing energy consumption in the building through improvements to its fabric. This reduces the energy required to run the building and thus the emissions associated with that energy use.

The new 2021 Part L is already very stringent in terms of fabric performance targets. It can be difficult to achieve further improvements over the fabric specification used for the 'Notional Building'. As such, further opportunities for improvement to the building fabric and services beyond those which meet the current 2021 Building Regulations requirements can be very limited. However, some further improvements are possible by considering the following steps:

- Reduce elemental U-Values
- Reducing heat loss through uncontrolled ventilation (air leakage)
- Use of MVHR units to reduce heat loss via controlled ventilation
- Address heat loss at junctions (thermal bridging)

The full specification used for modelling at this stage of the energy hierarchy can be found in Table 3.2, below.

[2] https://kb.goodhomes.org.uk/guidance/building-standards-compared/

Table 3.2: 'Be Lean' Specification	
Element	**Specification**
External Walls	0.16W/m^{2}K
Basement Walls	0.16W/m^{2}K
Walls to Stairwells/Unheated Spaces	0.16W/m^{2}K
Party Walls	0.00W/m^{2}K
Ground Floor	0.10W/m^{2}K
Flat Roof	0.10W/m^{2}K
Sloped Roof	0.10W/m^{2}K
Windows	1.00W/m^{2}K
Front Doors	1.00W/m^{2}K
Air Permeability	2.00m^3/m^2/hr
Thermal Bridging	Representative detailing for similar projects
Ventilation	MVHR
Lighting	LED lamps throughout (80 lumens/watt)
Space Heating	Mains gas combi boiler
DHW	From main heating system
LZC Technology	PV as per the Part L 2021 Notional Building

The improved 'Be Lean' carbon dioxide emissions and energy consumption figures as taken from the SAP10.2 model for the above specification are shown in Table 3.3, below, and the SAP worksheets can be found in Appendix 2.

Table 3.3: Total reduction in energy use and carbon emissions				
	Regulated Energy Consumption (kWh per annum)	**Regulated CO_2 Emissions (Tonnes per annum)**	**Regulated CO_2 savings**	
			(Tonnes per annum)	**(%)**
Baseline	29,728	6.6		
Be Lean	27,438	6.0	0.6	**10%**

3.4 'Be Clean' – Communal Heating & CHP

London Plan 2021 Policy SI3, Energy Infrastructure requires that connection to existing decentralised energy networks be considered. According to the Mayor's Heat Map (shown below as Figure 3.2) the site is located within a Heat Network Priority Area. However, no existing or proposed heat networks are shown in close proximity to the development site. The closest networks are over 1km away to the east of the site. This is not close enough to the development site to enable the cost of connection to be viable.

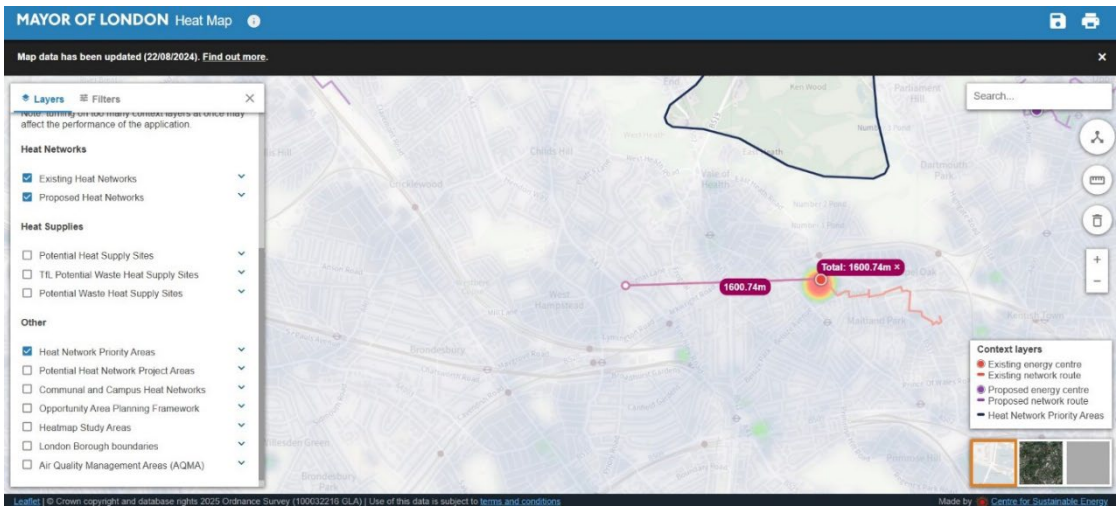

Figure 3.2: London Heat Map – Frognal Garages

As there is no relevant either existing or proposed DHN in connectable distance to the development site it is not considered to be possible to connect this development to a DHN.

Similarly, it is not considered viable to introduce a communal heating system into this development. Although the development is for 7 new flats this is still small scale when it comes to the viability of communal/district heating systems. These systems are also much better suited to mixed-use schemes, and this is an entirely residential development. The small scale would result in significant inefficiencies and the scheme is far too small to utilise CHP or provide an energy centre for surrounding buildings.

As such Table 3.4, below, shows the performance following the 'Be Clean' stage of the energy hierarchy.

Table 3.4: Total reduction in energy use and carbon emissions

	Regulated Energy Consumption (kWh per annum)	Regulated CO_2 Emissions (Tonnes per annum)	Regulated CO_2 savings	
			(Tonnes per annum)	(%)
Baseline	29,728	6.6		
Be Lean	27,438	6.0	0.6	**10%**
Be Clean	27,438	6.0	0.0	**0%**

3.5 'Be Green' – CO_2 Reduction Through the Use of LZC Technologies

Energy resources accepted as renewable or low carbon technologies are defined by the Department of Energy and Climate Change Low Carbon Buildings Program as:

- Solar photovoltaics
- Wind turbines
- Small hydro
- Solar thermal hot water
- Ground source heat pumps
- Air source heat pumps
- Bio-energy
- Renewable CHP
- Micro CHP (Combined heat and power)

Solar Photovoltaics

Solar panel electricity systems, also known as solar photovoltaics (PV), capture the sun's energy using photovoltaic cells. These cells do not need direct sunlight to work – they can still generate some electricity on a cloudy day. The cells convert the sunlight into electricity, which can be used to run household appliances and lighting. When excess power is generated this can be sold back to the grid or stored onsite.

The building design does not provide a large single roof area – it is split into several areas in a combination of flat and sloped angles. This significantly limits the available roofspace available for the installation of PV, and the presence of rooflights further reduces this space. As such there is only a very limited space available, and as a result PV is unlikely to provide a significant amount of electricity. As this will also need to be connected into the landlords supply, and will not reduce energy consumption from the flats themselves (given the amount of panels that could be fitted onto the roof, there would only be one panel per flat, which is not cost effective given this arrangement would need a dedicated inverter in each apartment) PV is not considered to be an appropriate technology for this development.

Wind Turbines

Wind turbines harness the power of the wind and use it to generate electricity. Forty percent of all the wind energy in Europe blows over the UK, making it an ideal country for domestic turbines. Urban sites such as the location of this development are generally unsuitable for wind turbine installations due to the interrupted turbulent wind flows caused by surrounding buildings and large obstacles. There are also possible issues with noise and 'flicker' for the neighbouring buildings.

The urban nature of the site and lack of space mean that a wind turbine cannot be recommended as a viable option for this development. There are also general issues surrounding the use of building mounted turbines with the potential for excessive noise and vibration within the building and the effect of flicker on surrounding buildings and amenity spaces.

Table 3.5: Average Wind Speeds	
45m above ground level	6.4m/s
25m above ground level	5.8m/s
10m above ground level	5.2m/s

Small Hydro Generation

Hydroelectricity generation uses running water to generate electricity, whether it is a small stream or a larger river. All streams and rivers flow downhill. Before the water flows down the hill, it has potential energy because of its height. Hydro power systems convert this potential energy into kinetic energy in a turbine, which drives a generator to produce electricity. Small, or 'micro' hydro generation requires a reliable source of flowing water with a reasonably constant flow velocity. Systems of this nature are normally installed in locations with a natural moving water source such as a river, stream or spring where part of the flow can be diverted through a generator.

There is no such source of flowing water in this case and small hydro generation is not an option for this development.

Solar Water heating

Solar water heating systems use free heat from the sun to warm domestic hot water. Solar hot water heating can generate a large proportion of a buildings annual DHW requirement. The displaced fuel would be mains gas meaning that the CO_2 savings of this type of system would be relatively low due to the low carbon intensity of the displaced fuel. However, this technology would need sufficient space on the roof for the panels and to provide heat to each apartment would need individual pipework taking down through the building. This technology cannot provide a significant carbon reduction on its own, so combination with another technology would be required. As PV is much simpler and more reliable to integrate into a building this technology is not considered suitable for this development.

Heat Pumps

Heat pumps use similar technology as refrigerators but reversed. A refrigerant liquid is used as a medium to extract heat from a source and convert it into useful heat energy. The heat source used can be generally one of three types; the ground, the air or a body of water. Both ground and water sourced heat pumps use a long circuitous pipe through which a refrigerant is pumped. In ground sourced heat pumps this can be either a coiled pipe or 'slinky' that is buried in a series of horizontal trenches or a loop inside a vertical bore hole to depths that

can be up to 200m or deeper. Water sourced heat pumps generally use a similar system to the 'slinky' used for ground sourced systems but either floated on or submerged in a body of water (either a large pool or running water source). Air source heat pumps have a refrigerant coil mounted outside the building through which is passed air so that heat can be extracted. All three types of heat pump generally use the collected heat from the source to heat water. The heated water can then be used for space heating and DHW. Heat pumps require an input of energy to drive pumps, this is usually electricity and so their renewable generation is the difference between the input and output energy. Most have very good efficiencies; energy produced by heat pumps is typically in the region of 2.5 times that which is required to run them, giving efficiencies of 250% and above.

Communal heat pumps are going to be difficult to integrate into this scheme due to the number of and the limited available space on the development site. However, individual ASHPs would be suitable as the condensers can be located on the roof. As such this technology is considered to be suitable for use on this development.

Bio Energy

The Low Carbon Buildings Program (LCBP) defines biomass as follows:

"Biomass is often called 'bioenergy' or 'biofuels'. These biofuels are produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. Biofuels fall into two main categories:

- *Woody biomass includes forest products, untreated wood products, energy crops, short rotation coppice (SRC), e.g. willow.*
- *Non-woody biomass includes animal waste, industrial and biodegradable municipal products from food processing and high energy crops, e.g. rape, sugar cane, maize."*

For small-scale domestic [and small scale commercial] applications of biomass the fuel usually takes the form of wood pellets, wood chips and logs. The LCBP goes on to state:

"There are two main ways of using biomass to heat a domestic property:

- *Stand-alone stoves providing space heating for a single room. These can be fuelled by logs or pellets but only pellets are suitable for automatic feed. Generally they are 5-11 kW in output, and some models can be fitted with a back boiler to provide water heating.*
- *Boilers connected to central heating and hot water systems. These are suitable for pellets, logs or chips, and are generally larger than 15 kW"*

(http://www.lowcarbonbuildings.org.uk/micro/biomass)

This technology is dismissed as the space requirements needed for the boiler and pellet store make this impractical along with complying with clean air zone requirements.

'Be Green' Modelled Performance

As identified above, the use o ASHPs have been identified as the most suitable technology for this development. Use of ASHPs for space heating and DHW heating will provide a large improvement in the overall energy consumption and, therefore, carbon emissions associated with the development.

The full specification used for modelling at this stage of the energy hierarchy can, therefore, be found in Table 3.6, below.

Table 3.6: 'Be Green' Specification	
Element	**Specification**
External Walls	0.16W/m^{2}K
Basement Walls	0.16W/m^{2}K
Walls to Stairwells/Unheated Spaces	0.16W/m^{2}K
Party Walls	0.00W/m^{2}K
Ground Floor	0.10W/m^{2}K
Flat Roof	0.10W/m^{2}K
Sloped Roof	0.10W/m^{2}K
Windows	1.00W/m^{2}K
Front Doors	1.00W/m^{2}K
Air Permeability	2.00m^3/m^2/hr
Thermal Bridging	Representative detailing for similar projects
Ventilation	MVHR
Lighting	LED lamps throughout (80 lumens/watt)
Space Heating	ASHP
DHW	DHW cylinder heated by main heating system
LZC Technology	None

The improved 'Be Green' carbon dioxide emissions and energy consumption figures as taken from the SAP10.2 models for the above specification are shown in Table 3.7, below, and the SAP Worksheets can be found in Appendix 3.

Table 3.7: Total reduction in energy use and carbon emissions				
	Regulated Energy Consumption (kWh per annum)	**Regulated CO_2 Emissions (Tonnes per annum)**	**Regulated CO_2 savings**	
			(Tonnes per annum)	**(%)**
Baseline	29,728	6.6		
Be Lean	27,438	6.0	0.6	**10%**
Be Clean	27,438	6.0	0.0	**0%**
Be Green	14,705	2.1	3.9	**59%**
Cumulative on site savings	**15,023**		**4.5**	**68%**

3.6 M & E Specification Information

Paragraph 10.9 of the GLA Energy Assessment Guidance (June 2022) document requires that specific information is provided when Heat Pumps are proposed for a development.

SCOP/SEER

For the purposes of this report the 'Be Green' SAP modelling has used the Mitsubishi Ecodan Monobloc series units. These are high efficiency Air to Water heat pumps utilising R32 refrigerant.

The data sheet for this unit can be found in Appendix 4, however the relevant information can be found in table 3.8 below.

Table 3.8: ASHP unit selection			
Apartment no.	**m2 Area**	**Heating Required (kW)**	**Unit Selected**
1	86	8.6	PUZ-WM112VAA
2	78	7.8	PUZ-WM85VAA
3	61	6.1	PUZ-WM85VAA
4	40	4	PUZ-WM60VAA
5	61	6.1	PUZ-WM85VAA

6	50	5	PUZ-WM60VAA
7	63	6.3	PUZ-WM85VAA

Integration with other heating/cooling technologies
No other heating technologies are proposed for this development – it is proposed that 100% of the space heating demand for the entire development will be provided by ASHPs.

The DHW will also be provided by the ASHP through the heating of a dedicated cylinder in the apartments. This will be provided with an immersion backup and the impact of this has been modelled through the SAP calculations.

Installation & minimum efficiencies
The proposed location of the external condensers is on the roof of the block in two defined enclosures – see Figure 3.3, below. Although no specific heat pump has been specified for performance purposes the dimensions of the condensers would be expected to be no larger than those of a Mitsubishi Ecodan. Full details of this, in terms of the manufacturer's data sheet and confirmation of the MCS certification can also be found in Appendix 4 to this report.

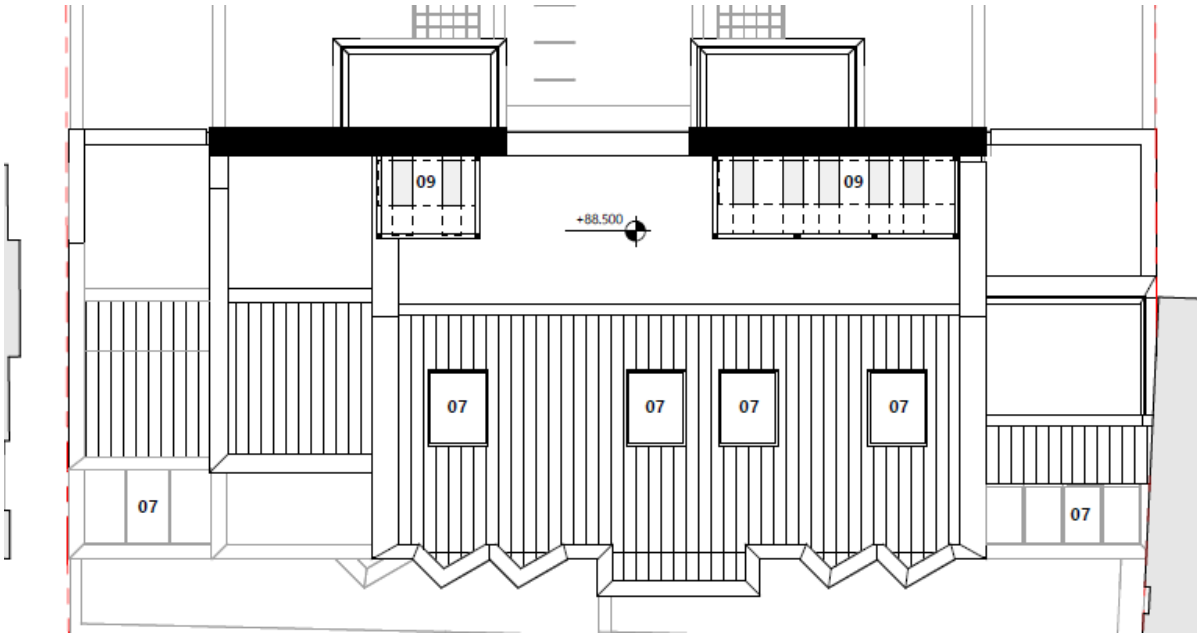

Figure 3.3: Roof layout showing ASHP & PV provision

Information Provision
Full details of the installation, controls, instructions for operation and details of the required maintenance regime will be provided to the occupants via their Home User Guide.

3.7 EUI, space heating demand & FEES

As required by the June 2022 updated guidance for the production of energy statements, the Energy Use Intensity (EUI), space heating demand and FEES performance should all be calculated and documented as part of the Energy Statement.

For this report all of these have been calculated using the same SAP10.2 models as the energy and CO_2 consumption. This information can be found in Table 3.9, below.

Table 3.9: EUI, space heating demand & FEES

Building Type	Energy Use Intensity	Space Heating Demand	Design Fabric Energy Efficiency (FEES)

	(kWh/m²/year, excluding renewable energy)	(kWh/m²/year, excluding renewable energy)	
Residential	52.3	11.0	33.97
Target	35.0	15.0	35.49

FEES

The target FEE in the above table is the area-weighted average taken from the TFEE of the SAP worksheets provided in Appendix 3 to this report. The as designed FEE in the above table is the area-weighted average taken from the DFEE of the 'Be Green' SAP worksheets provided as Appendix 3 to this report. This is around a 4% improvement over the FEES target of Part L 2021.

EUI

Energy Use Intensity (EUI) is defined as an annual measure of the total energy consumed within a building. This, therefore, is the total of both regulated and unregulated energy consumption. However, it does not include energy used for electric vehicle charging or any reductions due to on-site renewable energy generation. This total is then divided by the Gross Internal Area (GIA) to be expressed in kWh/m²/year.

Residential

The regulated energy consumption for the residential elements of the proposed development has been taken from the 'Be Green' SAP worksheets provided in Appendix 3 to this report. This equates to 14,705kWh/year for all regulated energy uses (space heating, DHW heating, lighting and ventilation).

The unregulated energy consumption, as per Section 3.2 of this report, has been calculated using information developed by the Good Homes Alliance in their Building Standards Compared[3] report. This comes to a total of 11,989kWh/year for the residential units. Adding this to the regulated energy as calculated above gives a total of 26,694Wh/year – and accounts for all unregulated energy used for cooking, appliances and small power in the residential units. This equates to an EUI of 52.3kWh/m²/year.

It should be noted that the targets set for this metric are based on modelling using the PassivHaus Planning Package. This uses a different set of modelling conventions, as well as produces a different set of performance figure even for the same building – particularly when it comes to the unregulated energy. As such it is not surprising that the modelled figures using SAP do not achieve the targets, as the development has been modelled using SAP in order to comply with the carbon calculation requirements of the GLA. It is also worth noting that the unregulated energy alone comes to 23.5kWh/m²/year, which makes the EUI targets seem extremely difficult, if not impossible, to achieve when using SAP10.2 as the modelling approach.

Space Heating Demand

The space heating demand of the residential units has been taken directly from Box 99 (Space Heating Requirement) of the DER calculations in the 'Be Green' SAP worksheets as provided in Appendix 3 to this report.

[3] https://kb.goodhomes.org.uk/guidance/building-standards-compared/

4.0 Running Costs

Section 3 of this report has identified the proposed energy strategy for the development. This section of the report will detail the steps that have been taken to protect the individual occupants/consumers from high energy costs.

In line with the energy hierarchy the proposed development has prioritised energy demand reduction as the main means by which this will be done. The proposed building fabric exceeds the requirements of the 2021 Part L (for new-build dwellings) by 4%. This will ensure that the energy consumption of the units within the development is reduced, limiting the impact of any price rises or energy cost increases in future.

No communal heating system has been specified for this development. The use of these systems can lock building occupants into restrictive contracts for space heating, where there is no ability for occupants to 'shop around' for different suppliers. In addition there is sometimes no ability for occupants to even turn off heating systems, depending on the specific billing arrangements. Ensuring that each unit has an individual electricity connection and meter gives the occupants the greatest flexibility to use only the energy they require and access the most competitive energy tariffs available on the market. In addition communal heating systems can add significant costs over the building lifespan relating to the maintenance and replacement of the equipment. Residents in a similar sized development (about 40 flats) have recently been charged over £33,000 per flat to replace life-expired communal heating plant. As this development is small scale in communal/district heating terms it is not expected that benefits of scale would outweigh the detriment to the occupants when it comes to the choice and access to lower cost energy tariffs that comes with individual heating systems.

Appendix 1

Drawings

mesbuildingsolutions.co.uk
Newark Beacon, Cafferata Way, Newark, Nottinghamshire NG24 2TN

01 GA Plan - level 01

1 : 100

scale (m)

0 1 2 5

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Do not scale from this drawing.

Use figured dimensions only.

- Residential - Living/Dining/Kitchen
- Residential - Bedroom
- Residential - Bathroom
- Residential - Communication
- Residential - Storage amenities
- Retained car parking space for 1 Frognal Lane (on Long Leasehold)
- Retained car parking space for 3 Frognal Lane (on Long Leasehold)
- Main entrance

01 Cycle storage (X spaces)
02 Bin enclosure
03 Angled windows
04 Planter
05 Lightweight bridge
06 Lightwell
07 Skylight
08 Hit & miss brickwork
09 Plant area
10 Canopy
XX* at high level
Assumed site boundary

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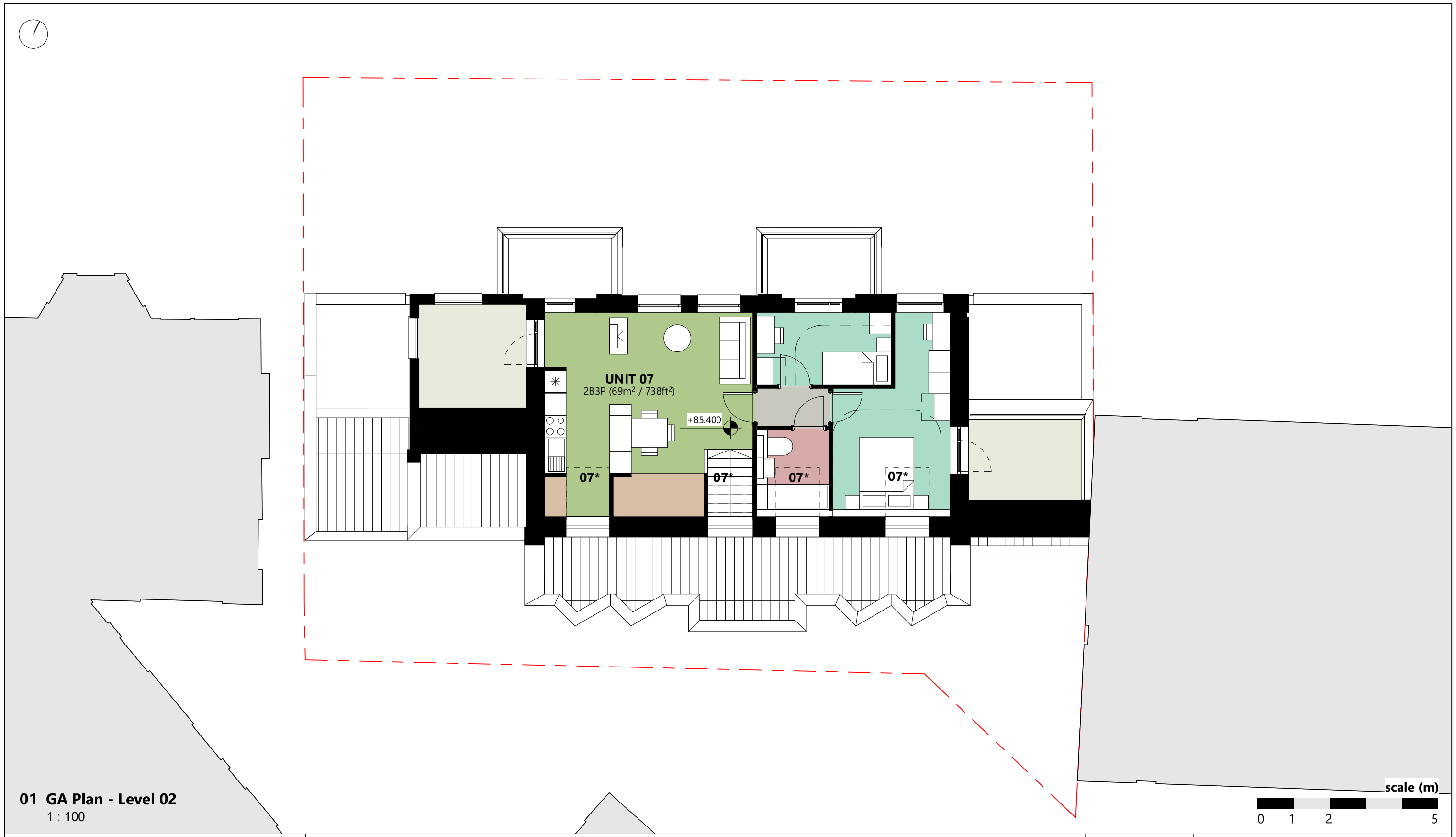
E: info@toddarch.co.uk

Client: Pollyshire Ltd

Project Name: Frognal Garages

Drawing Title: GA Plan - Level 01

Drawing Number: FGG-TOD-20-01-DR-A-20003



01 GA Plan - Level 02

1 : 100

scale (m)

0 1 2 5

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09 Plant area
10 Canopy
XX* at high level
Assumed site boundary

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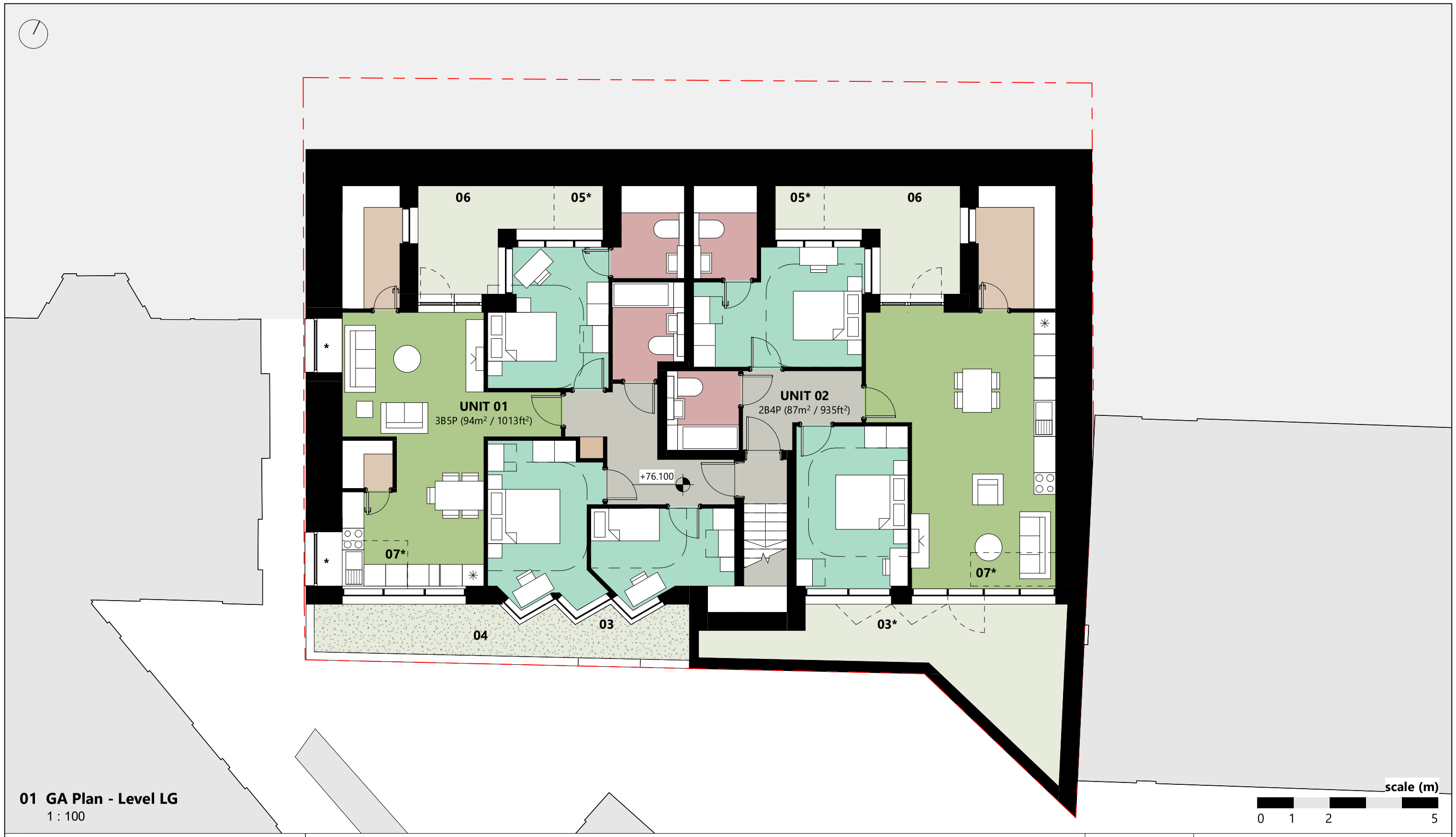

01 GA Plan - Level LG

1 : 100

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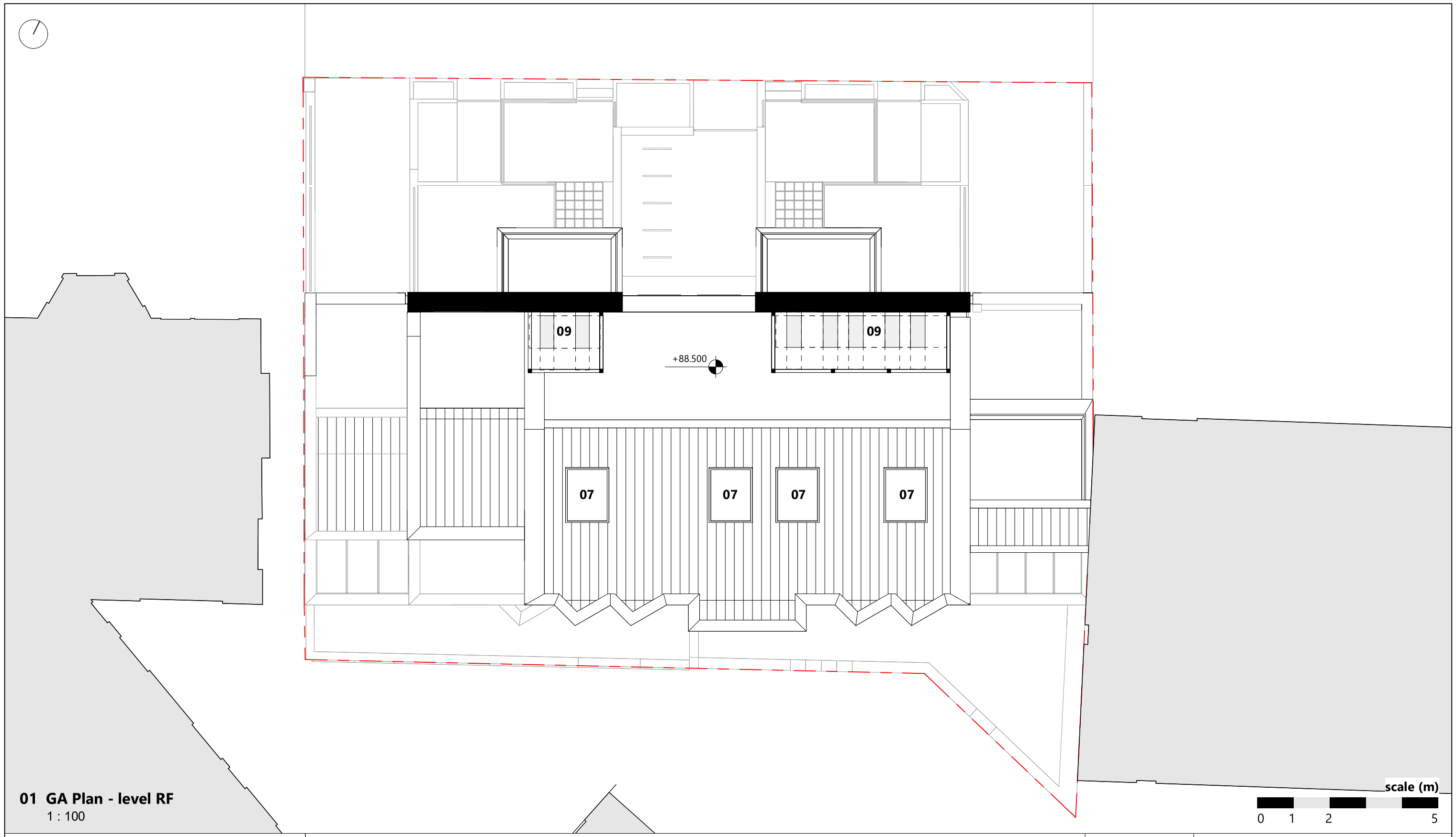

01 GA Plan - level RF

1 : 100

scale (m)

0 1 2 5

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01 GA Plan - Level UG

1 : 100

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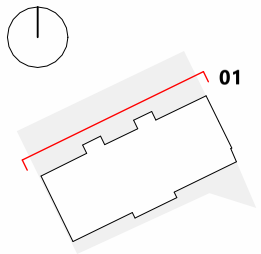

key plan

01 GA Elevation - North

1 : 100

scale (m)

0 1 2 5

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01 Light grey louvred screen
02 Frosted glass
03 Hit & Miss brickwork

notes:

- Window frames, sills and railings have a black PPC finish.
- The building is clad in red bricks with light grey GRC details.
- Cappings have a light grey PPC finish.

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Project Name: Frognal Garages
Drawing Title: GA Elevation - North
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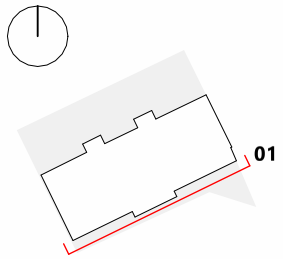

key plan

01 GA Elevation - South

1 : 100

scale (m)

0 1 2 5

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01 Light grey louvred screen
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03 Hit & Miss brickwork

notes:

- Window frames, sills and railings have a black PPC finish.
- The building is clad in red bricks with light grey GRC details.
- Cappings have a light grey PPC finish.

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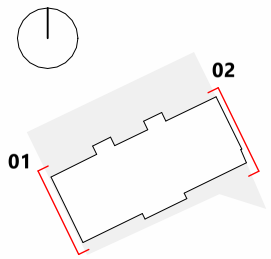
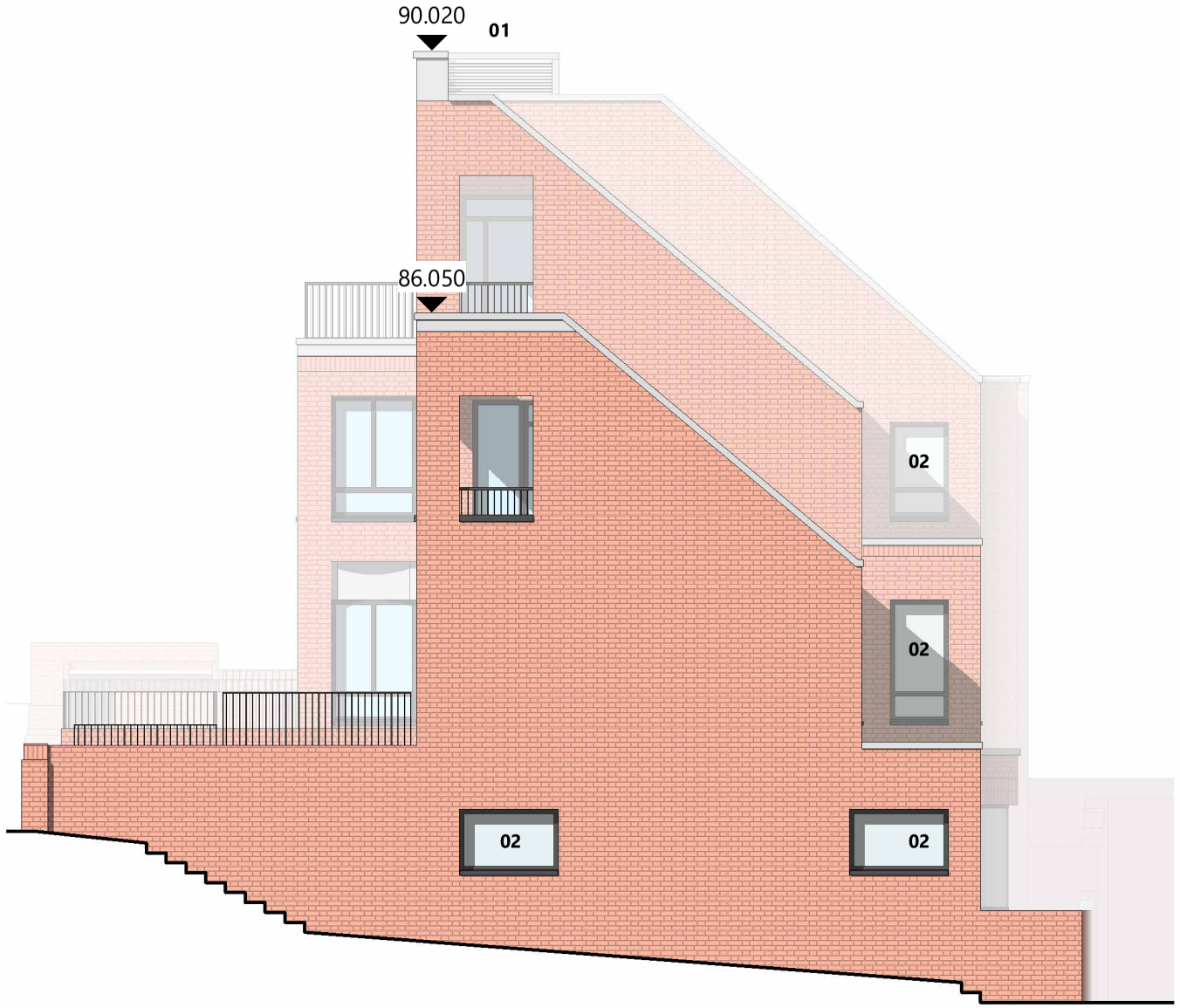
Client: Pollyshire Ltd
Project Name: Frognal Garages
Drawing Title: GA Elevation - South
Drawing Number: FGG-TOD-30-ZZ-DR-A-30002

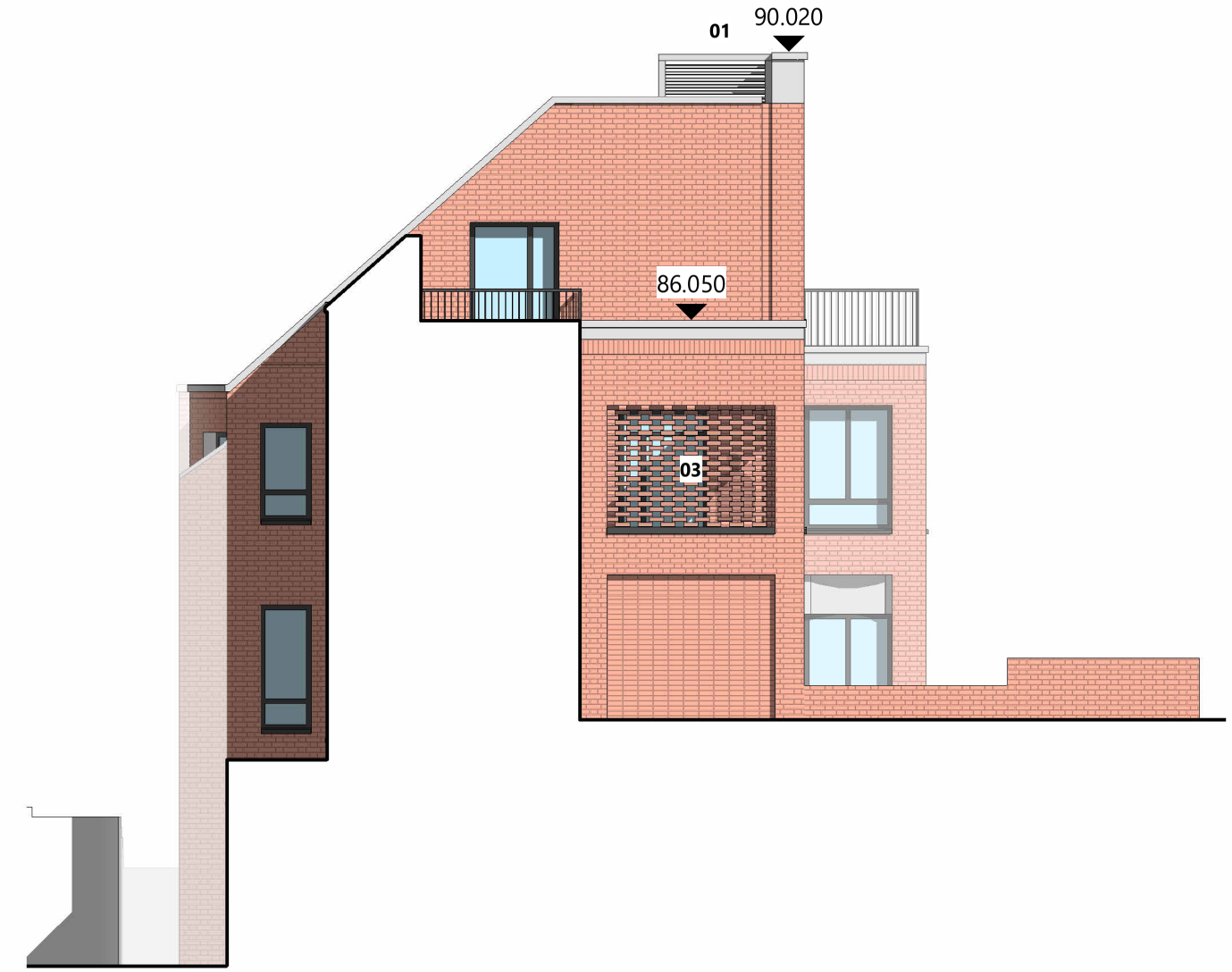


key plan



01 GA Elevation - West

1 : 100



02 GA Elevation - East

1 : 100

scale (m)

0 1 2 5

01 Light grey louvred screen
02 Frosted glass
03 Hit & Miss brickwork

notes:

- Window frames, sills and railings have a black PPC finish.
- The building is clad in red bricks with light grey GRC details.
- Cappings have a light grey PPC finish.

Rev:	Date:	Description:	Drwn by:	Chkd by:
P01	28/02/25	Planning Issue	JV	TB

Status: S2 - Information
Revision: P01
Dwn by: JV | Ckd by: TB
Scale: 1 : 100 | Page: A3
Project No: 21033V
Date: 28/02/25

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Client: Pollyshire Ltd
Project Name: Frognal Garages
Drawing Title: GA Elevation - East & West
Drawing Number: FGG-TOD-30-ZZ-DR-A-30003

Appendix 2

'Be Lean' SAP Worksheets

mesbuildingsolutions.co.uk
Newark Beacon, Cafferata Way, Newark, Nottinghamshire NG24 2TN

Full SAP Calculation Printout

Property Reference	Unit 01	**Issued on Date**	27/02/2025
Assessment Reference	Be Lean	**Prop Type Ref**	
Property	3, Frognal Lane, London, NW3 7DY		

SAP Rating	92 A	**DER**	10.45	**TER**	12.77
Environmental	91 B	**% DER < TER**			18.17
CO_2 Emissions (t/year)	0.83	**DFEE**	32.58	**TFEE**	38.14
Compliance Check	See BREL	**% DFEE < TFEE**			14.58
% DPER < TPER	23.37	**DPER**	51.72	**TPER**	67.49

Assessor Details	Mr. Maximus Cunningham	**Assessor ID**	DG68-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	87.5400	(1b)	x 2.6000	(2b) =	227.6040	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	227.6040	(5)

---

2. Ventilation rate

---

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		2.0000	(17)
Infiltration rate		0.1000	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1000	(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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000 (23c)

Effective ac	0.2090	0.2065	0.2040	0.1915	0.1890	0.1765	0.1765	0.1740	0.1815	0.1890	0.1940	0.1990	(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								
Windows			19.0100	0.9615	18.2788			(27)
FG Doors			4.0300	0.9615	3.8750			(27)
Heatloss Floor 1			87.5400	0.1000	8.7540	110.0000	9629.4000	(28a)
External Wall 1	82.2300	23.0400	59.1900	0.1600	9.4704	150.0000	8878.5005	(29a)
Wall to Corridor	9.1500		9.1500	0.1600	1.4640	150.0000	1372.4999	(29a)
Total net area of external elements Aum(A, m2)			178.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.8422			(33)
Main dwelling								
Party Wall 1			27.3300	0.0000	0.0000	70.0000	1913.1000	(32)
Party Ceiling 1			87.5400			100.0000	8754.0000	(32b)
Internal Wall 1			155.9000			9.0000	1403.0999	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	31950.6004 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		364.9829 (35)
List of Thermal Bridges		

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	10.9700	0.2210	2.4244	
E3 Sill	9.0200	0.0240	0.2165	
E4 Jamb	31.5000	0.0190	0.5985	
E5 Ground floor (normal)	31.6300	0.0390	1.2336	
E16 Corner (normal)	10.4000	0.0370	0.3848	
E18 Party wall between dwellings	5.2000	0.0270	0.1404	
E17 Corner (inverted - internal area greater than external area)	5.2000	-0.0790	-0.4108	
E25 Staggered party wall between dwellings	5.2000	0.0290	0.1508	
E7 Party floor between dwellings (in blocks of flats)	31.6300	0.0360	1.1387	
E7 Party floor between dwellings (in blocks of flats)	3.5200	0.2800	0.9856	
E5 Ground floor (normal)	3.5200	0.3200	1.1264	
P1 Party wall - Ground floor	10.5100	0.0370	0.3889	
E16 Corner (normal)	5.2000	0.1800	0.9360	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	10.5100	0.0000	0.0000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.3137 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	51.1559 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	15.6978	15.5101	15.3223	14.3834	14.1957	13.2568	13.2568	13.0690	13.6323	14.1957	14.5712	14.9468	(38)
Heat transfer coeff	66.8538	66.6660	66.4782	65.5394	65.3516	64.4127	64.4127	64.2249	64.7883	65.3516	65.7271	66.1027	(39)
Average = Sum(39)m / 12 =												65.4924	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7637	0.7615	0.7594	0.7487	0.7465	0.7358	0.7358	0.7337	0.7401	0.7465	0.7508	0.7551	(40)
HLP (average)												0.7481	
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		2.5905 (42)

Hot water usage for mixer showers

84.5680	83.2971	81.4452	77.9018	75.2869	72.3708	70.7133	72.5512	74.5659	77.6969	81.3164	84.2440	(42a)

Hot water usage for baths

29.2168	28.7829	28.1719	27.0452	26.2016	25.2662	24.7609	25.3677	26.0283	27.0293	28.1791	29.1181	(42b)

Hot water usage for other uses

41.1596	39.6629	38.1662	36.6695	35.1728	33.6760	33.6760	35.1728	36.6695	38.1662	39.6629	41.1596	(42c)

Average daily hot water use (litres/day)		142.4753 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	154.9444	151.7429	147.7832	141.6165	136.6613	131.3130	129.1502	133.0916	137.2637	142.8924	149.1584	154.5217	(44)
Energy conte	245.3941	216.0799	227.1373	193.8660	183.9724	161.4647	156.1960	164.7952	169.2599	193.9036	212.5035	241.9436	(45)
Energy content (annual)											Total = Sum(45)m =	2366.5162	

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

36.8091	32.4120	34.0706	29.0799	27.5959	24.2197	23.4294	24.7193	25.3890	29.0855	31.8755	36.2915	(46)

Water storage loss:		
Store volume		150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.8800 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		1.0152 (55)

Total storage loss

31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(56)

If cylinder contains dedicated solar storage

31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(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

300.1277	265.5167	281.8709	246.8340	238.7060	214.4327	210.9296	219.5288	222.2279	248.6372	265.4715	296.6772	(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

300.1277	265.5167	281.8709	246.8340	238.7060	214.4327	210.9296	219.5288	222.2279	248.6372	265.4715	296.6772	(64)
										Total per year (kWh/year) = Sum(64)m =	3010.9602	(64)
12Total per year (kWh/year)											3011	(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

125.3804	111.3960	119.3100	106.8348	104.9577	96.0614	95.7221	98.5813	98.6533	108.2598	113.0318	124.2331	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	118.2675	130.9390	118.2675	122.2097	118.2675	122.2097	118.2675	118.2675	122.2097	118.2675	122.2097	118.2675	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.4785	236.9116	230.7802	217.7270	201.2497	185.7634	175.4176	172.9844	179.1159	192.1691	208.6463	224.1327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	(71)
Water heating gains (Table 5)	168.5221	165.7679	160.3630	148.3817	141.0722	133.4186	128.6587	132.5017	137.0185	145.5105	156.9886	166.9800	(72)
Total internal gains	586.1260	598.4764	574.2685	553.1764	525.4473	503.2497	484.2017	485.6116	500.2020	520.8050	552.7026	574.2381	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W

North			6.6400	10.6334	0.4000	0.7000	0.7700				13.7003	(74)
South			12.3700	46.7521	0.4000	0.7000	0.7700				112.2178	(78)
North			2.1000	10.6334	0.4000	0.7000	0.7700				4.3329	(74)
South			1.9300	46.7521	0.4000	0.7000	0.7700				17.5085	(78)
Solar gains	147.7596	246.9208	329.1944	399.9381	445.4522	442.3929	426.3532	391.5348	353.1177	270.1793	176.0163	127.1289	(83)
Total gains	733.8855	845.3972	903.4629	953.1144	970.8994	945.6426	910.5548	877.1464	853.3197	790.9843	728.7189	701.3670	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	132.7549	133.1289	133.5049	135.4174	135.8065	137.7860	137.7860	138.1888	136.9873	135.8065	135.0305	134.2634	
alpha	9.8503	9.8753	9.9003	10.0278	10.0538	10.1857	10.1857	10.2126	10.1325	10.0538	10.0020	9.9509	
util living area	0.9944	0.9783	0.9348	0.8066	0.6239	0.4359	0.3113	0.3368	0.5235	0.8269	0.9770	0.9962	(86)
MIT	20.6339	20.7667	20.8869	20.9770	20.9980	21.0000	21.0000	21.0000	20.9997	20.9757	20.8087	20.6096	(87)
Th 2	20.2849	20.2868	20.2887	20.2980	20.2999	20.3093	20.3093	20.3112	20.3055	20.2999	20.2962	20.2924	(88)
util rest of house	0.9921	0.9703	0.9147	0.7680	0.5779	0.3889	0.2624	0.2864	0.4710	0.7826	0.9672	0.9945	(89)
MIT 2	19.8711	20.0371	20.1789	20.2797	20.2987	20.3093	20.3093	20.3112	20.3054	20.2818	20.0983	19.8469	(90)
Living area fraction									fLA = Living area / (4) =			0.3441	(91)
MIT	20.1336	20.2881	20.4225	20.5196	20.5393	20.5469	20.5470	20.5482	20.5443	20.5205	20.3427	20.1093	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.9836	20.1381	20.2725	20.3696	20.3893	20.3969	20.3970	20.3982	20.3943	20.3705	20.1927	19.9593	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9909	0.9684	0.9142	0.7721	0.5838	0.3948	0.2686	0.2927	0.4778	0.7873	0.9654	0.9935	(94)
Useful gains	727.1905	818.6438	825.9329	735.8594	566.7863	373.3783	244.5719	256.7828	407.6771	622.7438	703.5141	696.8358	(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	1048.5064	1015.8644	915.5722	751.7107	567.8621	373.3958	244.5722	256.7835	407.7971	638.5201	860.5472	1041.7326	(97)
Space heating kWh	239.0590	132.5323	66.6916	11.4129	0.8004	0.0000	0.0000	0.0000	0.0000	11.7376	113.0638	256.6032	(98a)
Space heating requirement - total per year (kWh/year)												831.9008	
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	239.0590	132.5323	66.6916	11.4129	0.8004	0.0000	0.0000	0.0000	0.0000	11.7376	113.0638	256.6032	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												831.9008	
Space heating per m2										(98c) / (4) =		9.5031	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.9000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	239.0590	132.5323	66.6916	11.4129	0.8004	0.0000	0.0000	0.0000	0.0000	11.7376	113.0638	256.6032	(98)
Space heating efficiency (main heating system 1)	88.9000	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000	(210)
Space heating fuel (main heating system)	268.9078	149.0802	75.0187	12.8379	0.9003	0.0000	0.0000	0.0000	0.0000	13.2031	127.1809	288.6425	(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	300.1277	265.5167	281.8709	246.8340	238.7060	214.4327	210.9296	219.5288	222.2279	248.6372	265.4715	296.6772	(64)
Efficiency of water heater												79.0000	(216)
(217)m	83.1031	82.0420	80.7199	79.3907	79.0294	79.0000	79.0000	79.0000	79.0000	79.3986	81.7181	83.3024	(217)
Fuel for water heating, kWh/month	361.1509	323.6352	349.1963	310.9103	302.0470	271.4338	266.9995	277.8846	281.3011	313.1507	324.8625	356.1449	(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	26.7605	24.1708	26.7605	25.8973	26.7605	25.8973	26.7605	26.7605	25.8973	26.7605	25.8973	26.7605	(231)
Lighting	31.6699	25.4067	22.8759	16.7599	12.9458	10.5769	11.8096	15.3506	19.9389	26.1609	29.5487	32.5501	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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												935.7714	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.0000	

Water heating fuel used	3738.7168	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	229.0834	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	315.0834	(231)
Electricity for lighting (calculated in Appendix L)	255.5939	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(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	-1081.7210	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4163.4445	(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	935.7714	0.2100	196.5120	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3738.7168	0.2100	785.1305	(264)
Space and water heating			981.6425	(265)
Pumps, fans and electric keep-hot	315.0834	0.1387	43.7060	(267)
Energy for lighting	255.5939	0.1443	36.8901	(268)
Appendix Q item 'pv' - energy saved	-1081.7210	0.1360	-147.1141	(270)
Appendix Q item 'pv' - energy used	0.0000	0.0000	0.0000	(271)
Total CO2, kg/year			915.1245	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.4500	(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	935.7714	1.1300	1057.4217	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3738.7168	1.1300	4224.7500	(278)
Space and water heating			5282.1717	(279)
Pumps, fans and electric keep-hot	315.0834	1.5128	476.6582	(281)
Energy for lighting	255.5939	1.5338	392.0384	(282)
Appendix Q item 'pv' - energy saved	-1081.7210	1.5010	-1623.6632	(284)
Appendix Q item 'pv' - energy used	0.0000	0.0000	0.0000	(285)
Total Primary energy kWh/year			4527.2051	(286)
Dwelling Primary energy Rate (DPER)			51.7200	(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	87.5400	(1b) x	2.6000	(2b) =	227.6040	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	227.6040	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1318	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3818	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3818	(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													
	0.4868	0.4773	0.4677	0.4200	0.4104	0.3627	0.3627	0.3532	0.3818	0.4104	0.4295	0.4486	(22b)
Effective ac	0.6185	0.6139	0.6094	0.5882	0.5842	0.5658	0.5658	0.5624	0.5729	0.5842	0.5922	0.6006	(25)

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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								
TER Opening Type			21.8800	1.1450	25.0534			(27)
Heatloss Floor 1			87.5400	0.1300	11.3802			(28a)
External Wall 1	82.2300	21.8800	60.3500	0.1800	10.8630			(29a)
Wall to Corridor	9.1500		9.1500	0.1800	1.6470			(29a)
Total net area of external elements Aum(A, m2)			178.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.9436			(33)
Main dwelling								
Party Wall 1			27.3300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 344.9829 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	10.9700	0.0500	0.5485
E3 Sill	9.0200	0.0500	0.4510
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	31.6300	0.1600	5.0608
E16 Corner (normal)	10.4000	0.0900	0.9360
E18 Party wall between dwellings	5.2000	0.0600	0.3120
E17 Corner (inverted - internal area greater than external area)	5.2000	-0.0900	-0.4680
E25 Staggered party wall between dwellings	5.2000	0.0600	0.3120
E7 Party floor between dwellings (in blocks of flats)	31.6300	0.0700	2.2141
E7 Party floor between dwellings (in blocks of flats)	3.5200	0.0700	0.2464
E5 Ground floor (normal)	3.5200	0.1600	0.5632
P1 Party wall - Ground floor	10.5100	0.0800	0.8408
E16 Corner (normal)	5.2000	0.0900	0.4680
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	10.5100	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.0598 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 62.0034 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.4543	46.1087	45.7700	44.1789	43.8813	42.4955	42.4955	42.2389	43.0293	43.8813	44.4835	45.1130	(38)
Heat transfer coeff													
	108.4578	108.1122	107.7734	106.1824	105.8847	104.4989	104.4989	104.2423	105.0327	105.8847	106.4869	107.1165	(39)
Average = Sum(39)m / 12 =												106.1810	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2390	1.2350	1.2311	1.2130	1.2096	1.1937	1.1937	1.1908	1.1998	1.2096	1.2164	1.2236	(40)
HLP (average)												1.2129	
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 2.5905 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers													
	67.6544	66.6377	65.1561	62.3215	60.2295	57.8966	56.5706	58.0410	59.6527	62.1575	65.0531	67.3952	(42a)
Hot water usage for baths													
	29.2168	28.7829	28.1719	27.0452	26.2016	25.2662	24.7609	25.3677	26.0283	27.0293	28.1791	29.1181	(42b)
Hot water usage for other uses													
	41.1596	39.6629	38.1662	36.6695	35.1728	33.6760	33.6760	35.1728	36.6695	38.1662	39.6629	41.1596	(42c)
Average daily hot water use (litres/day)												126.8815	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	138.0308	135.0835	131.4942	126.0362	121.6039	116.8389	115.0076	118.5814	122.3505	127.3530	132.8951	137.6729	(44)
Energy conte	218.6071	192.3571	202.1017	172.5372	163.7022	143.6670	139.0917	146.8285	150.8704	172.8168	189.3335	215.5624	(45)
Energy content (annual)										Total = Sum(45)m =		2107.4758	
Distribution loss (46)m = 0.15 x (45)m													
	32.7911	28.8536	30.3153	25.8806	24.5553	21.5501	20.8638	22.0243	22.6306	25.9225	28.4000	32.3344	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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													
	265.2020	234.4428	248.6966	217.6291	210.2971	188.7589	185.6866	193.4234	195.9623	219.4117	234.4253	262.1573	(62)
WWHRS	-30.9288	-27.3537	-28.6432	-23.7177	-22.1040	-18.9146	-17.7294	-18.8534	-19.5697	-23.0706	-26.1362	-30.3560	(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													
	234.2733	207.0892	220.0534	193.9114	188.1931	169.8443	167.9572	174.5700	176.3925	196.3412	208.2892	231.8013	(64)
									Total per year (kWh/year) = Sum(64)m =			2368.7160	(64)
12Total per year (kWh/year)												2369	(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													
	109.9628	97.6273	104.4747	93.4421	91.7069	83.8428	83.5239	86.0964	86.2379	94.7375	99.0269	108.9504	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	118.2675	130.9390	118.2675	122.2097	118.2675	122.2097	118.2675	118.2675	122.2097	118.2675	122.2097	118.2675	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	234.4785	236.9116	230.7802	217.7270	201.2497	185.7634	175.4176	172.9844	179.1159	192.1691	208.6463	224.1327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	(71)
Water heating gains (Table 5)													
	147.7994	145.2787	140.4230	129.7807	123.2620	116.4483	112.2633	115.7210	119.7748	127.3354	137.5373	146.4387	(72)
Total internal gains													
	565.4033	577.9873	554.3286	534.5753	507.6371	486.2793	467.8063	468.8308	482.9584	502.6298	533.2513	553.6968	(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	8.3000	10.6334	0.6300	0.7000	0.7700	26.9725	(74)
South	13.5800	46.7521	0.6300	0.7000	0.7700	194.0316	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	221.0041	369.3196	492.3764	598.1881	666.2638	661.6881	637.6974	585.6194	528.1586	404.1074	263.2677	190.1468	(83)
Total gains	786.4074	947.3069	1046.7050	1132.7634	1173.9009	1147.9674	1105.5037	1054.4502	1011.1170	906.7373	796.5190	743.8436	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	77.3465	77.5938	77.8377	79.0040	79.2261	80.2767	80.2767	80.4744	79.8688	79.2261	78.7781	78.3151	
alpha	6.1564	6.1729	6.1892	6.2669	6.2817	6.3518	6.3518	6.3650	6.3246	6.2817	6.2519	6.2210	
util living area													
	0.9967	0.9892	0.9707	0.9104	0.7768	0.5746	0.4150	0.4531	0.6897	0.9312	0.9903	0.9976	(86)
MIT	20.0443	20.2522	20.4910	20.7633	20.9319	20.9914	20.9990	20.9984	20.9744	20.7601	20.3549	20.0143	(87)
Th 2	19.8890	19.8921	19.8952	19.9096	19.9124	19.9250	19.9250	19.9274	19.9201	19.9124	19.9069	19.9011	(88)
util rest of house													
	0.9952	0.9846	0.9583	0.8756	0.7079	0.4822	0.3142	0.3484	0.5944	0.8961	0.9853	0.9965	(89)
MIT 2	18.8051	19.0704	19.3687	19.6974	19.8662	19.9215	19.9248	19.9270	19.9078	19.7044	19.2137	18.7761	(90)
Living area fraction									fLA = Living area / (4) =			0.3441	(91)
MIT	19.2315	19.4770	19.7549	20.0641	20.2329	20.2896	20.2944	20.2956	20.2748	20.0676	19.6064	19.2021	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2315	19.4770	19.7549	20.0641	20.2329	20.2896	20.2944	20.2956	20.2748	20.0676	19.6064	19.2021	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9939	0.9823	0.9563	0.8812	0.7294	0.5141	0.3489	0.3846	0.6270	0.9020	0.9834	0.9955	(94)
Useful gains	781.6426	930.5481	1000.9995	998.1767	856.3012	590.1375	385.7502	405.5149	633.9689	817.8407	783.3278	740.5161	(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													
	1619.4355	1575.9513	1428.5228	1185.4358	903.4985	594.5619	386.0651	406.0905	648.5547	1002.4765	1331.7644	1606.9775	(97)
Space heating kWh													
	623.3180	433.7109	318.0774	134.8266	35.1148	0.0000	0.0000	0.0000	0.0000	137.3690	394.8743	644.6473	(98a)
Space heating requirement - total per year (kWh/year)												2721.9383	
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													
	623.3180	433.7109	318.0774	134.8266	35.1148	0.0000	0.0000	0.0000	0.0000	137.3690	394.8743	644.6473	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2721.9383	
Space heating per m2											(98c) / (4) =	31.0937	(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													
	623.3180	433.7109	318.0774	134.8266	35.1148	0.0000	0.0000	0.0000	0.0000	137.3690	394.8743	644.6473	(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)													
	675.3174	469.8927	344.6125	146.0743	38.0442	0.0000	0.0000	0.0000	0.0000	148.8289	427.8162	698.4261	(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													
	234.2733	207.0892	220.0534	193.9114	188.1931	169.8443	167.9572	174.5700	176.3925	196.3412	208.2892	231.8013	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.1459	85.6772	84.8852	83.2610	81.0924	79.8000	79.8000	79.8000	79.8000	83.2742	85.4712	86.2280	(217)
Fuel for water heating, kWh/month													
	271.9494	241.7085	259.2366	232.8959	232.0725	212.8375	210.4727	218.7594	221.0433	235.7766	243.6952	268.8238	(219)
Space cooling fuel requirement													

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	24.5736	19.7139	17.7502	13.0045	10.0451	8.2069	9.1635	11.9110	15.4712	20.2991	22.9278	25.2566	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-23.2214	-34.2792	-51.5627	-60.7509	-67.9278	-64.2729	-63.4713	-58.7103	-50.7488	-40.3963	-26.0654	-19.8993	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-8.8226	-18.9242	-38.3057	-58.5668	-78.4685	-79.2344	-78.3192	-65.8543	-47.6589	-27.4183	-11.8910	-6.9510	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2949.0122	(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	2849.2713	(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)	198.3234	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1081.7210	(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	5000.8859	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2949.0122	0.2100	619.2926	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2849.2713	0.2100	598.3470	(264)
Space and water heating			1217.6395	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	198.3234	0.1443	28.6242	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-561.3061	0.1336	-75.0110	
PV Unit electricity exported	-520.4149	0.1254	-65.2453	
Total			-140.2563	(269)
Total CO2, kg/year			1117.9367	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.7700	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2949.0122	1.1300	3332.3838	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2849.2713	1.1300	3219.6765	(278)
Space and water heating			6552.0603	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	198.3234	1.5338	304.1950	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-561.3061	1.4938	-838.5038	
PV Unit electricity exported	-520.4149	0.4602	-239.4817	
Total			-1077.9855	(283)
Total Primary energy kWh/year			5908.3706	(286)
Target Primary Energy Rate (TPER)			67.4900	(287)

Full SAP Calculation Printout

Property Reference	Unit 03	**Issued on Date**	27/02/2025
Assessment Reference	Be Lean	**Prop Type Ref**	
Property	3, Frognal Lane, London, NW3 7DY		

SAP Rating	90 B	**DER**	13.13	**TER**	13.79
Environmental	90 B	**% DER < TER**			4.79
CO_2 Emissions (t/year)	0.73	**DFEE**	35.88	**TFEE**	34.74
Compliance Check	See BREL	**% DFEE < TFEE**			-3.29
% DPER < TPER	9.23	**DPER**	66.48	**TPER**	73.24

Assessor Details	Mr. Maximus Cunningham	**Assessor ID**	DG68-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	60.7700 (1b)	x	2.6000 (2b)	=	158.0020	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.7700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	158.0020	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		0 * 10 =	0.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5) =	0.0000	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			2.0000	(17)
Infiltration rate			0.1000	(18)
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1000	(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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000 (23c)

Effective ac	0.2090	0.2065	0.2040	0.1915	0.1890	0.1765	0.1765	0.1740	0.1815	0.1890	0.1940	0.1990	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			9.3200	0.9615	8.9615			(27)
FG Doors			2.2500	0.9615	2.1635			(27)
External Wall 1	47.6300	11.5700	36.0600	0.1600	5.7696	150.0000	5409.0000	(29a)
Wall to Corridor	19.6800		19.6800	0.1600	3.1488	150.0000	2952.0000	(29a)
Wall to Garage	15.5200		15.5200	0.1600	2.4832	150.0000	2328.0000	(29a)
Total net area of external elements Aum(A, m2)			82.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		22.5266			(33)
Main dwelling								
Party Wall 1			27.3300	0.0000	0.0000	70.0000	1913.1000	(32)
Party Floor 1			60.7700			80.0000	4861.6000	(32d)
Party Ceiling 1			60.7700			100.0000	6077.0000	(32b)
Internal Wall 1			90.0100			9.0000	810.0900	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	24350.7900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		400.7041 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E16 Corner (normal)	7.8000	0.0370	0.2886
E17 Corner (inverted - internal area greater than external area)	5.2000	-0.0790	-0.4108
E7 Party floor between dwellings (in blocks of flats)	40.2400	0.0360	1.4486
E7 Party floor between dwellings (in blocks of flats)	27.0800	0.2800	7.5824
E16 Corner (normal)	7.8000	0.1800	1.4040
E2 Other lintels (including other steel lintels)	8.0400	0.2210	1.7768
E3 Sill	6.9700	0.0240	0.1673
E4 Jamb	17.1000	0.0190	0.3249

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.5819 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.1085 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	10.8974	10.7670	10.6367	9.9849	9.8546	9.2028	9.2028	9.0725	9.4635	9.8546	10.1153	10.3760	(38)
Heat transfer coeff	46.0059	45.8755	45.7452	45.0934	44.9630	44.3113	44.3113	44.1809	44.5720	44.9630	45.2237	45.4845	(39)
Average = Sum(39)m / 12 =												45.0608	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7570	0.7549	0.7528	0.7420	0.7399	0.7292	0.7292	0.7270	0.7335	0.7399	0.7442	0.7485	(40)
HLP (average)												0.7415	
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 2.0033 (42)

Hot water usage for mixer showers

72.2608	71.1749	69.5925	66.5648	64.3304	61.8387	60.4224	61.9928	63.7143	66.3897	69.4824	71.9840	(42a)

Hot water usage for baths

24.9828	24.6118	24.0893	23.1260	22.4046	21.6047	21.1727	21.6915	22.2564	23.1123	24.0955	24.8984	(42b)

Hot water usage for other uses

35.1460	33.8680	32.5899	31.3119	30.0339	28.7558	28.7558	30.0339	31.3119	32.5899	33.8680	35.1460	(42c)

Average daily hot water use (litres/day) 121.7360 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	132.3897	129.6547	126.2717	121.0026	116.7689	112.1992	110.3508	113.7182	117.2826	122.0919	127.4459	132.0283	(44)
Energy conte	209.6729	184.6265	194.0749	165.6465	157.1933	137.9620	133.4598	140.8068	144.6212	165.6776	181.5700	206.7245	(45)
Energy content (annual)										Total = Sum(45)m =		2022.0361	

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

31.4509	27.6940	29.1112	24.8470	23.5790	20.6943	20.0190	21.1210	21.6932	24.8516	27.2355	31.0087	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8800 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0152 (55)
Total storage loss

31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(56)

If cylinder contains dedicated solar storage

31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(57)
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)
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)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

264.4065	234.0633	248.8085	218.6145	211.9269	190.9300	188.1934	195.5404	197.5892	220.4112	234.5380	261.4581	(62)
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)
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)
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)
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)

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

264.4065	234.0633	248.8085	218.6145	211.9269	190.9300	188.1934	195.5404	197.5892	220.4112	234.5380	261.4581	(64)
									Total per year (kWh/year) = Sum(64)m =		2666.4801	(64)

12Total per year (kWh/year) 2666 (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

113.5031	100.9378	108.3168	97.4519	96.0537	88.2468	88.1623	90.6052	90.4610	98.8747	102.7464	112.5228	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	89.3534	98.9269	89.3534	92.3318	89.3534	92.3318	89.3534	89.3534	92.3318	89.3534	92.3318	89.3534	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	174.8846	176.6994	172.1263	162.3906	150.1011	138.5507	130.8344	129.0196	133.5927	143.3284	155.6179	167.1683	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	(71)
Water heating gains (Table 5)	152.5579	150.2050	145.5871	135.3498	129.1044	122.5650	118.4977	121.7811	125.6402	132.8961	142.7034	151.2403	(72)
Total internal gains	472.8457	481.8811	463.1165	446.1221	424.6087	406.4973	391.7352	393.2039	404.6145	421.6276	446.7029	463.8117	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.2000	10.6334	0.4000	0.7000	0.7700	14.8558	(74)
South	2.1200	46.7521	0.4000	0.7000	0.7700	19.2322	(78)
North	2.2500	10.6334	0.4000	0.7000	0.7700	4.6424	(74)

Solar gains	38.7304	68.7594	103.4394	147.0505	184.2585	192.1429	181.3651	151.7886	118.0402	78.3285	46.8502	32.8730	(83)
Total gains	511.5761	550.6405	566.5559	593.1726	608.8672	598.6402	573.1003	544.9925	522.6547	499.9561	493.5531	496.6847	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	147.0271	147.4449	147.8650	150.0022	150.4371	152.6498	152.6498	153.1002	151.7569	150.4371	149.5698	148.7125	
alpha	10.8018	10.8297	10.8577	11.0001	11.0291	11.1767	11.1767	11.2067	11.1171	11.0291	10.9713	10.9142	
util living area	0.9958	0.9891	0.9689	0.8734	0.6833	0.4737	0.3402	0.3729	0.5878	0.8830	0.9840	0.9968	(86)
MIT	20.6750	20.7564	20.8563	20.9653	20.9974	21.0000	21.0000	21.0000	20.9996	20.9671	20.8202	20.6618	(87)
Th 2	20.2907	20.2926	20.2945	20.3039	20.3057	20.3151	20.3151	20.3170	20.3114	20.3057	20.3020	20.2982	(88)
util rest of house	0.9939	0.9843	0.9561	0.8377	0.6339	0.4230	0.2872	0.3175	0.5295	0.8421	0.9761	0.9953	(89)
MIT 2	19.9247	20.0280	20.1504	20.2758	20.3042	20.3151	20.3151	20.3170	20.3112	20.2809	20.1159	19.9146	(90)
Living area fraction										fLA = Living area / (4) =		0.3370	(91)
MIT	20.1775	20.2735	20.3883	20.5082	20.5378	20.5459	20.5459	20.5472	20.5432	20.5121	20.3533	20.1664	(92)
Temperature adjustment												-0.1500	
adjusted MIT	20.0275	20.1235	20.2383	20.3582	20.3878	20.3959	20.3959	20.3972	20.3932	20.3621	20.2033	20.0164	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9930	0.9828	0.9548	0.8407	0.6398	0.4290	0.2935	0.3240	0.5364	0.8457	0.9747	0.9945	(94)
Useful gains	507.9728	541.1937	540.9743	498.6558	389.5769	256.8132	168.2031	176.5994	280.3710	422.8203	481.0597	493.9547	(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	723.5585	698.3860	628.4603	516.6894	390.6296	256.8247	168.2032	176.5998	280.4996	438.9355	592.5788	719.4004	(97)
Space heating kWh	160.3958	105.6332	65.0896	12.9842	0.7832	0.0000	0.0000	0.0000	0.0000	11.9897	80.2938	167.7316	(98a)
Space heating requirement - total per year (kWh/year)												604.9011	
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	160.3958	105.6332	65.0896	12.9842	0.7832	0.0000	0.0000	0.0000	0.0000	11.9897	80.2938	167.7316	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												604.9011	
Space heating per m2											(98c) / (4) =	9.9539	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.9000	(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	160.3958	105.6332	65.0896	12.9842	0.7832	0.0000	0.0000	0.0000	0.0000	11.9897	80.2938	167.7316	(98)
Space heating efficiency (main heating system 1)	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000	88.9000	(210)
Space heating fuel (main heating system)	180.4227	118.8225	73.2166	14.6054	0.8810	0.0000	0.0000	0.0000	0.0000	13.4867	90.3192	188.6745	(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	264.4065	234.0633	248.8085	218.6145	211.9269	190.9300	188.1934	195.5404	197.5892	220.4112	234.5380	261.4581	(64)
Efficiency of water heater												79.0000	(216)
(217)m	82.4675	81.8338	80.8674	79.4963	79.0324	79.0000	79.0000	79.0000	79.0000	79.4565	81.3093	82.5946	(217)
Fuel for water heating, kWh/month	320.6188	286.0226	307.6748	274.9996	268.1519	241.6836	238.2195	247.5195	250.1129	277.3986	288.4518	316.5559	(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	20.8107	18.7967	20.8107	20.1394	20.8107	20.1394	20.8107	20.8107	20.1394	20.8107	20.1394	20.8107	(231)
Lighting	22.5417	18.0838	16.2824	11.9292	9.2145	7.5283	8.4057	10.9261	14.1919	18.6206	21.0319	23.1682	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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												680.4286	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.0000	
Water heating fuel used												3317.4095	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)

mechanical ventilation fans (SFP = 0.8250) 159.0290 (230a)

central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	245.0290	(231)
Electricity for lighting (calculated in Appendix L)	181.9241	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(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	-750.9274	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3673.8639	(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	680.4286	0.2100	142.8900	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3317.4095	0.2100	696.6560	(264)
Space and water heating			839.5460	(265)
Pumps, fans and electric keep-hot	245.0290	0.1387	33.9885	(267)
Energy for lighting	181.9241	0.1443	26.2573	(268)
Appendix Q item 'pv' - energy saved	-750.9274	0.1360	-102.1261	(270)
Appendix Q item 'pv' - energy used	0.0000	0.0000	0.0000	(271)
Total CO2, kg/year			797.6657	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.1300	(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	680.4286	1.1300	768.8844	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3317.4095	1.1300	3748.6727	(278)
Space and water heating			4517.5571	(279)
Pumps, fans and electric keep-hot	245.0290	1.5128	370.6799	(281)
Energy for lighting	181.9241	1.5338	279.0413	(282)
Appendix Q item 'pv' - energy saved	-750.9274	1.5010	-1127.1420	(284)
Appendix Q item 'pv' - energy used	0.0000	0.0000	0.0000	(285)
Total Primary energy kWh/year			4040.1363	(286)
Dwelling Primary energy Rate (DPER)			66.4800	(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	60.7700	(1b)	x 2.6000	(2b) =	158.0020	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.7700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		158.0020	(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	2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1266	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3766	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3766	(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	0.4801	0.4707	0.4613	0.4142	0.4048	0.3578	0.3578	0.3483	0.3766	0.4048	0.4237	0.4425	(22b)
Effective ac	0.6153	0.6108	0.6064	0.5858	0.5819	0.5640	0.5640	0.5607	0.5709	0.5819	0.5897	0.5979	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opening Type			11.5700	1.1450	13.2481			(27)
External Wall 1	47.6300	11.5700	36.0600	0.1800	6.4908			(29a)
Wall to Corridor	19.6800		19.6800	0.1800	3.5424			(29a)
Wall to Garage	15.5200		15.5200	0.1800	2.7936			(29a)
Total net area of external elements Aum(A, m2)			82.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.0749			(33)
Main dwelling								
Party Wall 1			27.3300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 380.7041 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	7.8000	0.0900	0.7020
E17 Corner (inverted - internal area greater than external area)	5.2000	-0.0900	-0.4680
E7 Party floor between dwellings (in blocks of flats)	40.2400	0.0700	2.8168
E7 Party floor between dwellings (in blocks of flats)	27.0800	0.0700	1.8956
E16 Corner (normal)	7.8000	0.0900	0.7020
E2 Other lintels (including other steel lintels)	8.0400	0.0500	0.4020
E3 Sill	6.9700	0.0500	0.3485
E4 Jamb	17.1000	0.0500	0.8550

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.2539 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 33.3288 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	32.0804	31.8471	31.6183	30.5438	30.3428	29.4070	29.4070	29.2337	29.7674	30.3428	30.7495	31.1747	(38)
Heat transfer coeff	65.4092	65.1759	64.9471	63.8726	63.6716	62.7358	62.7358	62.5625	63.0962	63.6716	64.0783	64.5034	(39)

Average = Sum(39)m / 12 = 63.8717

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0763	1.0725	1.0687	1.0511	1.0477	1.0323	1.0323	1.0295	1.0383	1.0477	1.0544	1.0614	(40)
HLP (average)												1.0510	
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 2.0033 (42)

Hot water usage for mixer showers

57.8087	56.9399	55.6740	53.2518	51.4643	49.4709	48.3379	49.5943	50.9715	53.1118	55.5859	57.5872	(42a)

Hot water usage for baths

24.9828	24.6118	24.0893	23.1260	22.4046	21.6047	21.1727	21.6915	22.2564	23.1123	24.0955	24.8984	(42b)

Hot water usage for other uses

35.1460	33.8680	32.5899	31.3119	30.0339	28.7558	28.7558	30.0339	31.3119	32.5899	33.8680	35.1460	(42c)

Average daily hot water use (litres/day) 108.4116 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.9375	115.4197	112.3532	107.6897	103.9028	99.8315	98.2664	101.3196	104.5398	108.8140	113.5494	117.6316	(44)
Energy conte	186.7842	164.3561	172.6827	147.4218	139.8731	122.7544	118.8447	125.4548	128.9080	147.6596	161.7720	184.1826	(45)
Energy content (annual)										Total = Sum(45)m =		1800.6938	
Distribution loss (46)m = 0.15 x (45)m	28.0176	24.6534	25.9024	22.1133	20.9810	18.4132	17.8267	18.8182	19.3362	22.1489	24.2658	27.6274	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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	233.3791	206.4418	219.2776	192.5136	186.4680	167.8463	165.4396	172.0497	173.9998	194.2545	206.8638	230.7775	(62)
WWHRS	-26.4277	-23.3729	-24.4747	-20.2660	-18.8872	-16.1619	-15.1492	-16.1097	-16.7218	-19.7131	-22.3326	-25.9383	(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	206.9514	183.0689	194.8029	172.2476	167.5808	151.6843	150.2903	155.9400	157.2781	174.5413	184.5312	204.8392	(64)
									Total per year (kWh/year) = Sum(64)m =			2103.7560	(64)
12Total per year (kWh/year)												2104	(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	99.3817	88.3170	94.6929	85.0912	83.7837	76.8893	76.7918	78.9897	78.9354	86.3727	89.8626	98.5166	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	89.3534	98.9269	89.3534	92.3318	89.3534	92.3318	89.3534	89.3534	92.3318	89.3534	92.3318	89.3534	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	174.8846	176.6994	172.1263	162.3906	150.1011	138.5507	130.8344	129.0196	133.5927	143.3284	155.6179	167.1683	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	(71)
Water heating gains (Table 5)													

	133.5775	131.4241	127.2754	118.1822	112.6125	106.7907	103.2147	106.1689	109.6325	116.0924	124.8092	132.4148	(72)
Total internal gains													
	453.8653	463.1002	444.8049	428.9545	408.1168	390.7231	376.4523	377.5917	388.6068	404.8239	428.8087	444.9863	(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	9.4500	10.6334	0.6300	0.7000	0.7700	30.7097	(74)
South	2.1200	46.7521	0.6300	0.7000	0.7700	30.2906	(78)

Solar gains	61.0003	108.2961	162.9170	231.6046	290.2071	302.6251	285.6500	239.0671	185.9133	123.3673	73.7891	51.7750	(83)
Total gains	514.8656	571.3963	607.7219	660.5591	698.3239	693.3482	662.1023	616.6588	574.5201	528.1912	502.5978	496.7613	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	98.2506	98.6024	98.9497	100.6143	100.9319	102.4375	102.4375	102.7213	101.8523	100.9319	100.2914	99.6303	
alpha	7.5500	7.5735	7.5966	7.7076	7.7288	7.8292	7.8292	7.8481	7.7902	7.7288	7.6861	7.6420	
util living area													
	0.9982	0.9954	0.9870	0.9419	0.8007	0.5757	0.4167	0.4661	0.7346	0.9591	0.9946	0.9986	(86)
MIT	20.2712	20.3942	20.5687	20.8095	20.9583	20.9970	20.9998	20.9995	20.9831	20.8032	20.5061	20.2581	(87)
Th 2	20.0202	20.0234	20.0264	20.0410	20.0437	20.0565	20.0565	20.0588	20.0516	20.0437	20.0382	20.0325	(88)
util rest of house													
	0.9973	0.9932	0.9804	0.9153	0.7365	0.4927	0.3275	0.3711	0.6452	0.9341	0.9915	0.9979	(89)
MIT 2	19.1879	19.3468	19.5689	19.8674	20.0163	20.0553	20.0564	20.0587	20.0437	19.8686	19.5019	19.1811	(90)
Living area fraction										fLA = Living area / (4) =		0.3370	(91)
MIT	19.5529	19.6998	19.9059	20.1849	20.3337	20.3727	20.3743	20.3758	20.3603	20.1836	19.8403	19.5441	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5529	19.6998	19.9059	20.1849	20.3337	20.3727	20.3743	20.3758	20.3603	20.1836	19.8403	19.5441	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9922	0.9794	0.9199	0.7571	0.5208	0.3576	0.4032	0.6755	0.9385	0.9906	0.9974	(94)
Useful gains	513.1717	566.9309	595.1987	607.6305	528.7145	361.0796	236.7379	248.6151	388.0766	495.7095	497.8860	495.4826	(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													
	997.6833	964.5896	870.6717	720.7953	549.7244	362.1540	236.7865	248.7345	395.0000	610.2003	816.3792	989.7444	(97)
Space heating kWh													
	360.4766	267.2266	204.9520	81.4786	15.6314	0.0000	0.0000	0.0000	0.0000	85.1812	229.3151	367.7307	(98a)
Space heating requirement - total per year (kWh/year)												1611.9922	
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													
	360.4766	267.2266	204.9520	81.4786	15.6314	0.0000	0.0000	0.0000	0.0000	85.1812	229.3151	367.7307	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1611.9922	
Space heating per m2											(98c) / (4) =	26.5261	(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													
	360.4766	267.2266	204.9520	81.4786	15.6314	0.0000	0.0000	0.0000	0.0000	85.1812	229.3151	367.7307	(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)													
	390.5488	289.5197	222.0498	88.2759	16.9354	0.0000	0.0000	0.0000	0.0000	92.2873	248.4454	398.4082	(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													
	206.9514	183.0689	194.8029	172.2476	167.5808	151.6843	150.2903	155.9400	157.2781	174.5413	184.5312	204.8392	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2916	84.9069	84.1739	82.4846	80.4961	79.8000	79.8000	79.8000	79.8000	82.5438	84.5482	85.3560	(217)
Fuel for water heating, kWh/month													
	242.6397	215.6115	231.4292	208.8239	208.1851	190.0806	188.3337	195.4136	197.0903	211.4531	218.2557	239.9821	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	18.5659	14.8942	13.4106	9.8252	7.5893	6.2005	6.9232	8.9990	11.6888	15.3363	17.3224	19.0819	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-16.3660	-24.2925	-36.7464	-43.5584	-48.9549	-46.4358	-45.8818	-42.3324	-36.4132	-28.7641	-18.4246	-14.0115	(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	-5.8788	-12.6411	-25.6400	-39.2716	-52.6730	-53.1865	-52.5487	-44.1400	-31.9011	-18.3126	-7.9247	-4.6278 (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	1746.4705	(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	2547.2984	(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)	149.8372	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-750.9274	(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	3778.6786	(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	1746.4705	0.2100	366.7588	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2547.2984	0.2100	534.9327	(264)
Space and water heating			901.6915	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	149.8372	0.1443	21.6261	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-402.1815	0.1335	-53.6943	
PV Unit electricity exported	-348.7458	0.1253	-43.7089	
Total			-97.4032	(269)
Total CO2, kg/year			837.8437	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.7900	(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	1746.4705	1.1300	1973.5116	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2547.2984	1.1300	2878.4472	(278)
Space and water heating			4851.9588	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	149.8372	1.5338	229.8252	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-402.1815	1.4934	-600.6018	
PV Unit electricity exported	-348.7458	0.4600	-160.4325	
Total			-761.0342	(283)
Total Primary energy kWh/year			4450.8506	(286)
Target Primary Energy Rate (TPER)			73.2400	(287)

Full SAP Calculation Printout

Property Reference	Unit 07	**Issued on Date**	27/02/2025
Assessment Reference	Be Lean	**Prop Type Ref**	
Property	3, Frognal Lane, London, NW3 7DY		

SAP Rating	93 A	**DER**	10.53	**TER**	11.24
Environmental	91 B	**% DER < TER**			6.32
CO_2 Emissions (t/year)	0.89	**DFEE**	30.96	**TFEE**	32.46
Compliance Check	See BREL	**% DFEE < TFEE**			4.61
% DPER < TPER	12.91	**DPER**	51.57	**TPER**	59.22

Assessor Details	Mr. Maximus Cunningham	**Assessor ID**	DG68-0001
Client			

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

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1. Overall dwelling characteristics

		Area		Storey height		Volume	
Main dwelling		(m2)		(m)		(m3)	
Ground floor		92.6000	(1b)	x 1.9600	(2b) =	181.4960	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.6000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		181.4960	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		2.0000	(17)
Infiltration rate		0.1000	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1000	(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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000 (23c)

Effective ac	0.2090	0.2065	0.2040	0.1915	0.1890	0.1765	0.1765	0.1740	0.1815	0.1890	0.1940	0.1990	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Windows			12.9100	0.9615	12.4135			(27)
FG Doors			10.0800	0.9615	9.6923			(27)
External Wall 1	60.9600	22.9900	37.9700	0.1600	6.0752	150.0000	5695.5000	(29a)
Wall to Corridor	23.1500		23.1500	0.1600	3.7040	150.0000	3472.5000	(29a)
Flat Roof	46.4000		46.4000	0.1000	4.6400	9.0000	417.6000	(30)
Slope Roof	54.0200		54.0200	0.1000	5.4020	9.0000	486.1800	(30)
Total net area of external elements Aum(A, m2)			184.5300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.9270			(33)
Main dwelling								
Party Floor 1			92.6000			80.0000	7408.0000	(32d)
Internal Wall 1			67.8900			9.0000	611.0100	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	18090.7900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		195.3649 (35)
List of Thermal Bridges		

	Length	Psi-value	Total	
K1 Element				
E16 Corner (normal)	5.0000	0.0370	0.1850	
E7 Party floor between dwellings (in blocks of flats)	28.5100	0.0360	1.0264	
E7 Party floor between dwellings (in blocks of flats)	9.5700	0.2800	2.6796	
E16 Corner (normal)	10.0000	0.1800	1.8000	
E2 Other lintels (including other steel lintels)	14.0500	0.2210	3.1051	
E3 Sill	14.0500	0.0240	0.3372	
E4 Jamb	36.2400	0.0190	0.6886	
E14 Flat roof	19.3400	0.1600	3.0944	
E13 Gable (insulation at rafter level)	9.6500	0.0280	0.2702	
E11 Eaves (insulation at rafter level)	10.2800	0.0180	0.1850	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			13.3714	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	55.2984	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	12.5178	12.3680	12.2183	11.4696	11.3199	10.5712	10.5712	10.4215	10.8707	11.3199	11.6194	11.9188	(38)
Heat transfer coeff	67.8162	67.6664	67.5167	66.7680	66.6183	65.8696	65.8696	65.7199	66.1691	66.6183	66.9178	67.2172	(39)
Average = Sum(39)m / 12 =												66.7306	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7324	0.7307	0.7291	0.7210	0.7194	0.7113	0.7113	0.7097	0.7146	0.7194	0.7227	0.7259	(40)
HLP (average)												0.7206	
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												2.6597	(42)
Hot water usage for mixer showers	86.0169	84.7243	82.8406	79.2365	76.5768	73.6108	71.9248	73.7942	75.8435	79.0281	82.7096	85.6874	(42a)
Hot water usage for baths	29.7153	29.2740	28.6525	27.5067	26.6486	25.6973	25.1834	25.8005	26.4724	27.4904	28.6599	29.6148	(42b)
Hot water usage for other uses	41.8676	40.3451	38.8227	37.3002	35.7778	34.2553	34.2553	35.7778	37.3002	38.8227	40.3451	41.8676	(42c)
Average daily hot water use (litres/day)												144.9170	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	157.5998	154.3434	150.3158	144.0434	139.0032	133.5633	131.3635	135.3725	139.6161	145.3412	151.7146	157.1698	(44)
Energy conte	249.5996	219.7829	231.0298	197.1882	187.1251	164.2317	158.8728	167.6194	172.1606	197.2267	216.1453	246.0899	(45)
Energy content (annual)										Total = Sum(45)m =		2407.0720	
Distribution loss (46)m = 0.15 x (45)m	37.4399	32.9674	34.6545	29.5782	28.0688	24.6348	23.8309	25.1429	25.8241	29.5840	32.4218	36.9135	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0152	(55)
Total storage loss	31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(56)
If cylinder contains dedicated solar storage	31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(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	304.3332	269.2197	285.7634	250.1562	241.8587	217.1997	213.6064	222.3530	225.1286	251.9603	269.1133	300.8235	(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	304.3332	269.2197	285.7634	250.1562	241.8587	217.1997	213.6064	222.3530	225.1286	251.9603	269.1133	300.8235	(64)
										Total per year (kWh/year) = Sum(64)m =		3051.5160	(64)
12Total per year (kWh/year)												3052	(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	126.7788	112.6273	120.6043	107.9395	106.0060	96.9814	96.6121	99.5203	99.6178	109.3648	114.2427	125.6118	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	122.9593	136.1335	122.9593	127.0579	122.9593	127.0579	122.9593	122.9593	127.0579	122.9593	127.0579	122.9593	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.7806	246.3102	239.9355	226.3645	209.2336	193.1329	182.3766	179.8470	186.2217	199.7927	216.9236	233.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	(71)
Water heating gains (Table 5)	170.4015	167.6001	162.1025	149.9160	142.4811	134.6964	129.8549	133.7639	138.3581	146.9956	158.6704	168.8330	(72)
Total internal gains	603.0363	615.9388	590.8923	569.2333	540.5689	517.7822	498.0858	499.4651	514.5326	535.6425	568.5469	590.7116	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.2900	10.6334	0.4000	0.7000	0.7700	15.0415	(74)
South	5.6200	46.7521	0.4000	0.7000	0.7700	50.9834	(78)
North	4.6200	10.6334	0.4000	0.7000	0.7700	9.5325	(74)
East	2.7300	19.6403	0.4000	0.7000	0.7700	10.4040	(76)

West				2.7300		19.6403		0.4000		0.7000		0.7700	10.4040 (80)
Solar gains	96.3653	171.1646	253.1964	346.1574	417.7537	428.0545	407.1380	351.6124	285.0170	194.2620	116.6930	81.6519 (83)	
Total gains	699.4017	787.1034	844.0887	915.3907	958.3227	945.8367	905.2238	851.0775	799.5496	729.9046	685.2399	672.3635 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.1006	74.2646	74.4293	75.2639	75.4330	76.2904	76.2904	76.4642	75.9451	75.4330	75.0955	74.7609	
alpha	5.9400	5.9510	5.9620	6.0176	6.0289	6.0860	6.0860	6.0976	6.0630	6.0289	6.0064	5.9841	
util living area													
	0.9774	0.9552	0.9116	0.7989	0.6292	0.4439	0.3200	0.3548	0.5627	0.8344	0.9524	0.9813 (86)	
MIT	20.3081	20.4796	20.6768	20.8816	20.9744	20.9973	20.9997	20.9995	20.9897	20.8705	20.5713	20.2754 (87)	
Th 2	20.3123	20.3138	20.3152	20.3223	20.3237	20.3308	20.3308	20.3323	20.3280	20.3237	20.3209	20.3180 (88)	
util rest of house													
	0.9726	0.9465	0.8954	0.7690	0.5882	0.3982	0.2714	0.3035	0.5109	0.8019	0.9417	0.9773 (89)	
MIT 2	19.5102	19.7242	19.9650	20.2058	20.3022	20.3291	20.3307	20.3320	20.3208	20.1997	19.8462	19.4737 (90)	
Living area fraction										fLA = Living area / (4) =		0.3563 (91)	
MIT	19.7944	19.9933	20.2186	20.4466	20.5417	20.5672	20.5690	20.5698	20.5591	20.4387	20.1045	19.7593 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	19.6444	19.8433	20.0686	20.2966	20.3917	20.4172	20.4190	20.4198	20.4091	20.2887	19.9545	19.6093 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9669	0.9395	0.8889	0.7678	0.5924	0.4041	0.2778	0.3102	0.5172	0.8000	0.9349	0.9722 (94)	
Useful gains	676.2852	739.4728	750.3504	702.8162	567.7095	382.2429	251.4840	264.0349	413.5464	583.9525	640.6016	653.6763 (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													
	1040.6009	1011.1602	916.1067	760.9264	579.0267	383.1767	251.5589	264.1803	417.4660	645.4443	860.1969	1035.7723 (97)	
Space heating kWh													
	271.0509	182.5739	123.3227	41.8393	8.4200	0.0000	0.0000	0.0000	0.0000	45.7499	158.1086	284.2794 (98a)	
Space heating requirement - total per year (kWh/year)												1115.3447	
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													
	271.0509	182.5739	123.3227	41.8393	8.4200	0.0000	0.0000	0.0000	0.0000	45.7499	158.1086	284.2794 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												1115.3447	
Space heating per m2											(98c) / (4) =	12.0448 (99)	

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)	
Fraction of space heat from main system(s)												1.0000 (202)	
Efficiency of main space heating system 1 (in %)												88.9000 (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													
	271.0509	182.5739	123.3227	41.8393	8.4200	0.0000	0.0000	0.0000	0.0000	45.7499	158.1086	284.2794 (98)	
Space heating efficiency (main heating system 1)													
	88.9000	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000 (210)	
Space heating fuel (main heating system)													
	304.8941	205.3700	138.7207	47.0634	9.4713	0.0000	0.0000	0.0000	0.0000	51.4622	177.8500	319.7744 (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													
	304.3332	269.2197	285.7634	250.1562	241.8587	217.1997	213.6064	222.3530	225.1286	251.9603	269.1133	300.8235 (64)	
Efficiency of water heater												79.0000 (216)	
(217)m	83.3738	82.7227	81.7442	80.2810	79.2971	79.0000	79.0000	79.0000	79.0000	80.3755	82.3958	83.5189 (217)	
Fuel for water heating, kWh/month													
	365.0227	325.4485	349.5824	311.6007	305.0033	274.9363	270.3878	281.4595	284.9729	313.4791	326.6105	360.1863 (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	22.8190	20.6107	22.8190	22.0829	22.8190	22.0829	22.8190	22.8190	22.0829	22.8190	22.0829	22.8190 (231)	
Lighting	33.1627	26.6044	23.9543	17.5499	13.5561	11.0754	12.3663	16.0742	20.8788	27.3941	30.9416	34.0844 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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												1254.6060 (211)	
Space heating fuel - main system 2												0.0000 (213)	
Space heating fuel - secondary												0.0000 (215)	
Efficiency of water heater												79.0000	
Water heating fuel used												3768.6899 (219)	
Space cooling fuel												0.0000 (221)	

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	182.6757	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	268.6757	(231)
Electricity for lighting (calculated in Appendix L)	267.6424	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(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	-1144.2468	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4415.3673	(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	1254.6060	0.2100	263.4673	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3768.6899	0.2100	791.4249	(264)
Space and water heating			1054.8921	(265)
Pumps, fans and electric keep-hot	268.6757	0.1387	37.2686	(267)
Energy for lighting	267.6424	0.1443	38.6291	(268)
Appendix Q item 'pv' - energy saved	-1144.2468	0.1360	-155.6176	(270)
Appendix Q item 'pv' - energy used	0.0000	0.0000	0.0000	(271)
Total CO2, kg/year			975.1723	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.5300	(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	1254.6060	1.1300	1417.7048	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3768.6899	1.1300	4258.6196	(278)
Space and water heating			5676.3244	(279)
Pumps, fans and electric keep-hot	268.6757	1.5128	406.4526	(281)
Energy for lighting	267.6424	1.5338	410.5188	(282)
Appendix Q item 'pv' - energy saved	-1144.2468	1.5010	-1717.5144	(284)
Appendix Q item 'pv' - energy used	0.0000	0.0000	0.0000	(285)
Total Primary energy kWh/year			4775.7814	(286)
Dwelling Primary energy Rate (DPER)			51.5700	(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	92.6000	(1b)	x 1.9600	(2b) =	181.4960	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		181.4960	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1653	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4153	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4153	(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													
	0.5295	0.5191	0.5087	0.4568	0.4464	0.3945	0.3945	0.3841	0.4153	0.4464	0.4672	0.4880	(22b)
Effective ac	0.6402	0.6347	0.6294	0.6043	0.5997	0.5778	0.5778	0.5738	0.5862	0.5997	0.6091	0.6191	(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								
TER Opening Type			22.9900	1.1450	26.3244			(27)
External Wall 1	60.9600	22.9900	37.9700	0.1800	6.8346			(29a)
Wall to Corridor	23.1500		23.1500	0.1800	4.1670			(29a)
Flat Roof	46.4000		46.4000	0.1100	5.1040			(30)
Slope Roof	54.0200		54.0200	0.1100	5.9422			(30)
Total net area of external elements Aum(A, m2)			184.5300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.3722			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			195.3649 (35)
List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E16 Corner (normal)	5.0000	0.0900	0.4500
E7 Party floor between dwellings (in blocks of flats)	28.5100	0.0700	1.9957
E7 Party floor between dwellings (in blocks of flats)	9.5700	0.0700	0.6699
E16 Corner (normal)	10.0000	0.0900	0.9000
E2 Other lintels (including other steel lintels)	14.0500	0.0500	0.7025
E3 Sill	14.0500	0.0500	0.7025
E4 Jamb	36.2400	0.0500	1.8120
E14 Flat roof	19.3400	0.0800	1.5472
E13 Gable (insulation at rafter level)	9.6500	0.0800	0.7720
E11 Eaves (insulation at rafter level)	10.2800	0.0400	0.4112
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.9630 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	58.3352 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.3430	38.0170	37.6974	36.1963	35.9155	34.6081	34.6081	34.3660	35.1117	35.9155	36.4836	37.0776	(38)
Heat transfer coeff													
	96.6782	96.3522	96.0326	94.5316	94.2507	92.9434	92.9434	92.7013	93.4469	94.2507	94.8189	95.4128	(39)
Average = Sum(39)m / 12 =												94.5302	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0440	1.0405	1.0371	1.0209	1.0178	1.0037	1.0037	1.0011	1.0091	1.0178	1.0240	1.0304	(40)
HLP (average)												1.0208	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6597	(42)
Hot water usage for mixer showers													
	68.8136	67.7794	66.2725	63.3892	61.2615	58.8886	57.5399	59.0354	60.6748	63.2225	66.1677	68.5499	(42a)
Hot water usage for baths													
	29.7153	29.2740	28.6525	27.5067	26.6486	25.6973	25.1834	25.8005	26.4724	27.4904	28.6599	29.6148	(42b)
Hot water usage for other uses													
	41.8676	40.3451	38.8227	37.3002	35.7778	34.2553	34.2553	35.7778	37.3002	38.8227	40.3451	41.8676	(42c)
Average daily hot water use (litres/day)												129.0560	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	140.3964	137.3985	133.7477	128.1961	123.6879	118.8412	116.9785	120.6136	124.4474	129.5356	135.1727	140.0323	(44)
Energy conte	222.3537	195.6537	205.5652	175.4941	166.5077	146.1291	141.4754	149.3449	153.4561	175.7786	192.5783	219.2568	(45)
Energy content (annual)										Total = Sum(45)m =		2143.5934	
Distribution loss (46)m = 0.15 x (45)m													
	33.3530	29.3481	30.8348	26.3241	24.9761	21.9194	21.2213	22.4017	23.0184	26.3668	28.8867	32.8885	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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													
	268.9486	237.7394	252.1601	220.5859	213.1026	191.2209	188.0703	195.9398	198.5479	222.3735	237.6702	265.8517	(62)
WWHRS	-31.4587	-27.8223	-29.1339	-24.1240	-22.4827	-19.2386	-18.0332	-19.1765	-19.9050	-23.4658	-26.5840	-30.8761	(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													
	237.4899	209.9171	223.0262	196.4619	190.6198	171.9823	170.0371	176.7633	178.6429	198.9077	211.0862	234.9756	(64)
										Total per year (kWh/year) = Sum(64)m =		2399.9099	(64)
12Total per year (kWh/year)												2400	(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													
	111.2085	98.7234	105.6264	94.4253	92.6397	84.6614	84.3165	86.9331	87.0976	95.7223	100.1058	110.1788	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	122.9593	136.1335	122.9593	127.0579	122.9593	127.0579	122.9593	122.9593	127.0579	122.9593	127.0579	122.9593	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	243.7806	246.3102	239.9355	226.3645	209.2336	193.1329	182.3766	179.8470	186.2217	199.7927	216.9236	233.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	(69)

Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	(71)
Water heating gains (Table 5)	149.4738	146.9099	141.9709	131.1462	124.5158	117.5853	113.3286	116.8456	120.9689	128.6590	139.0358	148.0898	(72)
Total internal gains	582.1086	595.2485	570.7607	550.4636	522.6035	500.6710	481.5595	482.5467	497.1435	517.3059	548.9123	569.9683	(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	11.9100	10.6334	0.6300	0.7000	0.7700	38.7040	(74)
East	2.7300	19.6403	0.6300	0.7000	0.7700	16.3863	(76)
South	5.6200	46.7521	0.6300	0.7000	0.7700	80.2988	(78)
West	2.7300	19.6403	0.6300	0.7000	0.7700	16.3863	(80)

Solar gains	151.7754	269.5842	398.7843	545.1979	657.9621	674.1858	641.2423	553.7895	448.9018	305.9627	183.7914	128.6017	(83)
Total gains	733.8840	864.8328	969.5450	1095.6614	1180.5657	1174.8568	1122.8018	1036.3362	946.0452	823.2686	732.7037	698.5700	(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	51.9788	52.1547	52.3283	53.1592	53.3176	54.0675	54.0675	54.2087	53.7762	53.3176	52.9981	52.6682	
alpha	4.4653	4.4770	4.4886	4.5439	4.5545	4.6045	4.6045	4.6139	4.5851	4.5545	4.5332	4.5112	
util living area	0.9836	0.9663	0.9307	0.8368	0.6816	0.4952	0.3620	0.4074	0.6392	0.8835	0.9677	0.9866	(86)
MIT	19.7210	19.9738	20.2966	20.6731	20.8963	20.9811	20.9964	20.9939	20.9421	20.6355	20.1236	19.6867	(87)
Th 2	20.0468	20.0497	20.0526	20.0660	20.0685	20.0802	20.0802	20.0824	20.0757	20.0685	20.0634	20.0581	(88)
util rest of house	0.9797	0.9585	0.9151	0.8040	0.6286	0.4283	0.2874	0.3281	0.5675	0.8514	0.9590	0.9833	(89)
MIT 2	18.5697	18.8891	19.2897	19.7432	19.9822	20.0687	20.0789	20.0799	20.0358	19.7143	19.0909	18.5344	(90)
Living area fraction										fLA = Living area / (4) =		0.3563	(91)
MIT	18.9799	19.2756	19.6484	20.0745	20.3079	20.3938	20.4057	20.4055	20.3587	20.0425	19.4588	18.9449	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9799	19.2756	19.6484	20.0745	20.3079	20.3938	20.4057	20.4055	20.3587	20.0425	19.4588	18.9449	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9739	0.9507	0.9073	0.8043	0.6427	0.4514	0.3140	0.3563	0.5903	0.8504	0.9518	0.9781	(94)
Useful gains	714.7191	822.1616	879.6981	881.2745	758.7936	530.3568	352.5295	369.2194	558.4379	700.0764	697.4078	683.2998	(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	1419.2233	1385.1163	1262.6794	1056.3433	811.2978	538.4924	353.7184	371.3172	584.8540	889.9629	1171.8474	1406.8553	(97)
Space heating kWh	524.1512	378.3056	284.9381	126.0495	39.0632	0.0000	0.0000	0.0000	0.0000	141.2756	341.5965	538.3253	(98a)
Space heating requirement - total per year (kWh/year)												2373.7049	
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	524.1512	378.3056	284.9381	126.0495	39.0632	0.0000	0.0000	0.0000	0.0000	141.2756	341.5965	538.3253	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2373.7049	
Space heating per m2											(98c) / (4) =	25.6340	(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	524.1512	378.3056	284.9381	126.0495	39.0632	0.0000	0.0000	0.0000	0.0000	141.2756	341.5965	538.3253	(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)	567.8777	409.8652	308.7086	136.5650	42.3219	0.0000	0.0000	0.0000	0.0000	153.0613	370.0937	583.2344	(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	237.4899	209.9171	223.0262	196.4619	190.6198	171.9823	170.0371	176.7633	178.6429	198.9077	211.0862	234.9756	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7833	85.3642	84.6103	83.0914	81.1997	79.8000	79.8000	79.8000	79.8000	83.3064	85.1329	85.8577	(217)
Fuel for water heating, kWh/month	276.8487	245.9075	263.5923	236.4407	234.7545	215.5166	213.0791	221.5079	223.8633	238.7663	247.9490	273.6804	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	25.5485	20.4960	18.4543	13.5204	10.4436	8.5325	9.5270	12.3835	16.0850	21.1044	23.8373	26.2586	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.4830	-36.0982	-54.2331	-63.8149	-71.2784	-67.4114	-66.5659	-61.6068	-53.3066	-42.5000	-27.4649	-20.9849	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													

(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-9.4132	-20.1805	-40.8299	-62.3996	-83.5799	-84.3909	-83.4203	-70.1580	-50.7893	-29.2344	-12.6854	-7.4173	(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	2571.7279	(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	2891.9063	(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)	206.1911	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1144.2468	(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	4611.5786	(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	2571.7279	0.2100	540.0629	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2891.9063	0.2100	607.3003	(264)
Space and water heating			1147.3632	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	206.1911	0.1443	29.7598	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-589.7481	0.1337	-78.8277	
PV Unit electricity exported	-554.4986	0.1254	-69.5245	
Total			-148.3521	(269)
Total CO2, kg/year			1040.7001	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.2400	(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	2571.7279	1.1300	2906.0525	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2891.9063	1.1300	3267.8541	(278)
Space and water heating			6173.9067	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	206.1911	1.5338	316.2628	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-589.7481	1.4939	-881.0510	
PV Unit electricity exported	-554.4986	0.4602	-255.1887	
Total			-1136.2397	(283)
Total Primary energy kWh/year			5484.0307	(286)
Target Primary Energy Rate (TPER)			59.2200	(287)

Appendix 3

'Be Green' SAP Worksheets

mesbuildingsolutions.co.uk
Newark Beacon, Cafferata Way, Newark, Nottinghamshire NG24 2TN

Full SAP Calculation Printout

Property Reference	Unit 01	**Issued on Date**	27/02/2025
Assessment Reference	Be Green	**Prop Type Ref**	
Property	3, Frognal Lane, London, NW3 7DY		

SAP Rating	83 B	**DER**	3.86	**TER**	12.84
Environmental	97 A	**% DER < TER**			69.94
CO_2 Emissions (t/year)	0.32	**DFEE**	32.58	**TFEE**	38.14
Compliance Check	See BREL	**% DFEE < TFEE**			14.58
% DPER < TPER	39.30	**DPER**	41.18	**TPER**	67.84

Assessor Details	Mr. Maximus Cunningham	**Assessor ID**	DG68-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	87.5400	(1b)	x 2.6000	(2b) =	227.6040	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	227.6040	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		2.0000	(17)
Infiltration rate		0.1000	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1000	(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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000 (23c)

Effective ac	0.2090	0.2065	0.2040	0.1915	0.1890	0.1765	0.1765	0.1740	0.1815	0.1890	0.1940	0.1990	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			19.0100	0.9615	18.2788			(27)
FG Doors			4.0300	0.9615	3.8750			(27)
Heatloss Floor 1			87.5400	0.1000	8.7540	110.0000	9629.4000	(28a)
External Wall 1	82.2300	23.0400	59.1900	0.1600	9.4704	150.0000	8878.5005	(29a)
Wall to Corridor	9.1500		9.1500	0.1600	1.4640	150.0000	1372.4999	(29a)
Total net area of external elements Aum(A, m2)			178.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.8422			(33)
Main dwelling								
Party Wall 1			27.3300	0.0000	0.0000	70.0000	1913.1000	(32)
Party Ceiling 1			87.5400			100.0000	8754.0000	(32b)
Internal Wall 1			155.9000			9.0000	1403.0999	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	31950.6004 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		364.9829 (35)
List of Thermal Bridges		

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	10.9700	0.2210	2.4244	
E3 Sill	9.0200	0.0240	0.2165	
E4 Jamb	31.5000	0.0190	0.5985	
E5 Ground floor (normal)	31.6300	0.0390	1.2336	
E16 Corner (normal)	10.4000	0.0370	0.3848	
E18 Party wall between dwellings	5.2000	0.0270	0.1404	
E17 Corner (inverted - internal area greater than external area)	5.2000	-0.0790	-0.4108	
E25 Staggered party wall between dwellings	5.2000	0.0290	0.1508	
E7 Party floor between dwellings (in blocks of flats)	31.6300	0.0360	1.1387	
E7 Party floor between dwellings (in blocks of flats)	3.5200	0.2800	0.9856	
E5 Ground floor (normal)	3.5200	0.3200	1.1264	
P1 Party wall - Ground floor	10.5100	0.0370	0.3889	
E16 Corner (normal)	5.2000	0.1800	0.9360	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	10.5100	0.0000	0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.3137	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	51.1559	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	15.6978	15.5101	15.3223	14.3834	14.1957	13.2568	13.2568	13.0690	13.6323	14.1957	14.5712	14.9468	(38)
Heat transfer coeff	66.8538	66.6660	66.4782	65.5394	65.3516	64.4127	64.4127	64.2249	64.7883	65.3516	65.7271	66.1027	(39)
Average = Sum(39)m / 12 =												65.4924	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7637	0.7615	0.7594	0.7487	0.7465	0.7358	0.7358	0.7337	0.7401	0.7465	0.7508	0.7551	(40)
HLP (average)												0.7481	
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											2.5905	(42)
Hot water usage for mixer showers												
	67.6544	66.6377	65.1561	62.3215	60.2295	57.8966	56.5706	58.0410	59.6527	62.1575	65.0531	67.3952	(42a)
Hot water usage for baths												
	29.2168	28.7829	28.1719	27.0452	26.2016	25.2662	24.7609	25.3677	26.0283	27.0293	28.1791	29.1181	(42b)
Hot water usage for other uses												
	41.1596	39.6629	38.1662	36.6695	35.1728	33.6760	33.6760	35.1728	36.6695	38.1662	39.6629	41.1596	(42c)
Average daily hot water use (litres/day)												126.8815	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.0308	135.0835	131.4942	126.0362	121.6039	116.8389	115.0076	118.5814	122.3505	127.3530	132.8951	137.6729	(44)
Energy conte	218.6071	192.3571	202.1017	172.5372	163.7022	143.6670	139.0917	146.8285	150.8704	172.8168	189.3335	215.5624	(45)
Energy content (annual)										Total = Sum(45)m =		2107.4758	
Distribution loss (46)m = 0.15 x (45)m													
	32.7911	28.8536	30.3153	25.8806	24.5553	21.5501	20.8638	22.0243	22.6306	25.9225	28.4000	32.3344	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0152	(55)
Total storage loss													
	31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(56)
If cylinder contains dedicated solar storage													
	31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(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													
	273.3407	241.7939	256.8353	225.5052	218.4358	196.6350	193.8253	201.5621	203.8384	227.5504	242.3015	270.2960	(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													
	273.3407	241.7939	256.8353	225.5052	218.4358	196.6350	193.8253	201.5621	203.8384	227.5504	242.3015	270.2960	(64)
										Total per year (kWh/year) = Sum(64)m =		2751.9198	(64)
12Total per year (kWh/year)												2752	(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													
	116.4737	103.5082	110.9857	99.7430	98.2179	90.1437	90.0349	92.6074	92.5388	101.2485	105.3278	115.4614	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	118.2675	130.9390	118.2675	122.2097	118.2675	122.2097	118.2675	118.2675	122.2097	118.2675	122.2097	118.2675	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	234.4785	236.9116	230.7802	217.7270	201.2497	185.7634	175.4176	172.9844	179.1159	192.1691	208.6463	224.1327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	(71)
Water heating gains (Table 5)	156.5507	154.0300	149.1743	138.5320	132.0133	125.1996	121.0146	124.4723	128.5261	136.0867	146.2886	155.1900	(72)
Total internal gains	571.1546	583.7386	560.0799	540.3266	513.3884	495.0306	476.5576	477.5821	491.7097	508.3811	539.0026	559.4481	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W

North			6.6400	10.6334	0.4000	0.7000	0.7700	13.7003	(74)
South			12.3700	46.7521	0.4000	0.7000	0.7700	112.2178	(78)
North			2.1000	10.6334	0.4000	0.7000	0.7700	4.3329	(74)
South			1.9300	46.7521	0.4000	0.7000	0.7700	17.5085	(78)
Solar gains	147.7596	246.9208	329.1944	399.9381	445.4522	442.3929	426.3532	391.5348	353.1177	270.1793	176.0163	127.1289	(83)
Total gains	718.9142	830.6594	889.2743	940.2647	958.8405	937.4235	902.9108	869.1169	844.8274	778.5604	715.0189	686.5770	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	132.7549	133.1289	133.5049	135.4174	135.8065	137.7860	137.7860	138.1888	136.9873	135.8065	135.0305	134.2634	
alpha	9.8503	9.8753	9.9003	10.0278	10.0538	10.1857	10.1857	10.2126	10.1325	10.0538	10.0020	9.9509	
util living area	0.9953	0.9808	0.9404	0.8151	0.6315	0.4397	0.3139	0.3399	0.5288	0.8366	0.9799	0.9968	(86)
Living	20.6836	20.7847	20.8778	20.9500	20.9674	20.9693	20.9694	20.9695	20.9690	20.9488	20.8173	20.6657	
Non living	19.9212	20.0485	20.1595	20.2430	20.2591	20.2700	20.2700	20.2720	20.2660	20.2449	20.0982	19.9052	
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	20.8382	20.7847	20.8778	20.9500	20.9674	20.9693	20.9694	20.9695	20.9690	20.9488	20.8173	20.7124	(87)
Th 2	20.2849	20.2868	20.2887	20.2980	20.2999	20.3093	20.3093	20.3112	20.3055	20.2999	20.2962	20.2924	(88)
util rest of house	0.9933	0.9737	0.9214	0.7768	0.5850	0.3923	0.2646	0.2890	0.4758	0.7928	0.9711	0.9954	(89)
MIT 2	20.1399	20.0485	20.1595	20.2430	20.2591	20.2700	20.2700	20.2720	20.2660	20.2449	20.0982	19.9750	(90)
Living area fraction										fLA = Living area / (4) =		0.3441	(91)
MIT	20.3802	20.3018	20.4067	20.4862	20.5028	20.5106	20.5107	20.5120	20.5078	20.4871	20.3456	20.2287	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3802	20.3018	20.4067	20.4862	20.5028	20.5106	20.5107	20.5120	20.5078	20.4871	20.3456	20.2287	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9936	0.9738	0.9249	0.7875	0.5986	0.4061	0.2790	0.3039	0.4912	0.8051	0.9718	0.9953	(94)
Useful gains	714.3312	808.9297	822.4565	740.4203	573.9191	380.6963	251.8953	264.0908	414.9953	626.8125	694.8745	683.3263	(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	1075.0191	1026.7760	924.4906	759.3546	575.2771	380.7197	251.8957	264.0917	415.1531	646.1381	870.5980	1059.5406	(97)
Space heating kWh	268.3518	146.3927	75.9134	13.6327	1.0103	0.0000	0.0000	0.0000	0.0000	14.3782	126.5210	279.9034	(98a)
Space heating requirement - total per year (kWh/year)												926.1035	
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	268.3518	146.3927	75.9134	13.6327	1.0103	0.0000	0.0000	0.0000	0.0000	14.3782	126.5210	279.9034	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												926.1035	
Space heating per m2											(98c) / (4) =	10.5792	(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 %)												278.6742	(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	268.3518	146.3927	75.9134	13.6327	1.0103	0.0000	0.0000	0.0000	0.0000	14.3782	126.5210	279.9034	(98)
Space heating efficiency (main heating system 1)	278.6742	278.6742	278.6742	278.6742	278.6742	0.0000	0.0000	0.0000	0.0000	278.6742	278.6742	278.6742	(210)
Space heating fuel (main heating system)	96.2959	52.5318	27.2409	4.8920	0.3625	0.0000	0.0000	0.0000	0.0000	5.1595	45.4010	100.4411	(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	273.3407	241.7939	256.8353	225.5052	218.4358	196.6350	193.8253	201.5621	203.8384	227.5504	242.3015	270.2960	(64)
Efficiency of water heater												179.0400	(216)
(217)m	179.0400	179.0400	179.0400	179.0400	179.0400	179.0400	179.0400	179.0400	179.0400	179.0400	179.0400	179.0400	(217)
Fuel for water heating, kWh/month	152.6702	135.0502	143.4513	125.9524	122.0039	109.8274	108.2581	112.5794	113.8508	127.0947	135.3337	150.9696	(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	19.4564	17.5735	19.4564	18.8288	19.4564	18.8288	19.4564	19.4564	18.8288	19.4564	18.8288	19.4564	(231)
Lighting	31.6699	25.4067	22.8759	16.7599	12.9458	10.5769	11.8096	15.3506	19.9389	26.1609	29.5487	32.5501	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	332.3248	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	179.0400	
Water heating fuel used	1537.0419	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	229.0834	(230a)
Total electricity for the above, kWh/year	229.0834	(231)
Electricity for lighting (calculated in Appendix L)	255.5939	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(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	2354.0439	(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	332.3248	0.1593	52.9457	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1537.0419	0.1409	216.5800	(264)
Space and water heating			269.5257	(265)
Pumps, fans and electric keep-hot	229.0834	0.1387	31.7767	(267)
Energy for lighting	255.5939	0.1443	36.8901	(268)
Total CO2, kg/year			338.1925	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.8600	(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	332.3248	1.5897	528.2890	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1537.0419	1.5210	2337.8768	(278)
Space and water heating			2866.1658	(279)
Pumps, fans and electric keep-hot	229.0834	1.5128	346.5574	(281)
Energy for lighting	255.5939	1.5338	392.0384	(282)
Total Primary energy kWh/year			3604.7616	(286)
Dwelling Primary energy Rate (DPER)			41.1800	(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	87.5400	(1b)	x 2.6000	(2b) =	227.6040	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.5400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	227.6040	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1318	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3818	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3818	(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												
	0.4868	0.4773	0.4677	0.4200	0.4104	0.3627	0.3627	0.3532	0.3818	0.4104	0.4295	0.4486 (22b)
Effective ac	0.6185	0.6139	0.6094	0.5882	0.5842	0.5658	0.5658	0.5624	0.5729	0.5842	0.5922	0.6006 (25)

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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								
TER Opening Type			21.8800	1.1450	25.0534			(27)
Heatloss Floor 1			87.5400	0.1300	11.3802			(28a)
External Wall 1	82.2300	21.8800	60.3500	0.1800	10.8630			(29a)
Wall to Corridor	9.1500		9.1500	0.1800	1.6470			(29a)
Total net area of external elements Aum(A, m2)			178.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.9436			(33)
Main dwelling								
Party Wall 1			27.3300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	344.9829	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	10.9700	0.0500	0.5485
E3 Sill	9.0200	0.0500	0.4510
E4 Jamb	31.5000	0.0500	1.5750
E5 Ground floor (normal)	31.6300	0.1600	5.0608
E16 Corner (normal)	10.4000	0.0900	0.9360
E18 Party wall between dwellings	5.2000	0.0600	0.3120
E17 Corner (inverted - internal area greater than external area)	5.2000	-0.0900	-0.4680
E25 Staggered party wall between dwellings	5.2000	0.0600	0.3120
E7 Party floor between dwellings (in blocks of flats)	31.6300	0.0700	2.2141
E7 Party floor between dwellings (in blocks of flats)	3.5200	0.0700	0.2464
E5 Ground floor (normal)	3.5200	0.1600	0.5632
P1 Party wall - Ground floor	10.5100	0.0800	0.8408
E16 Corner (normal)	5.2000	0.0900	0.4680
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	10.5100	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.0598	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	62.0034	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.4543	46.1087	45.7700	44.1789	43.8813	42.4955	42.4955	42.2389	43.0293	43.8813	44.4835	45.1130	(38)
Heat transfer coeff	108.4578	108.1122	107.7734	106.1824	105.8847	104.4989	104.4989	104.2423	105.0327	105.8847	106.4869	107.1165	(39)
Average = Sum(39)m / 12 =												106.1810	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2390	1.2350	1.2311	1.2130	1.2096	1.1937	1.1937	1.1908	1.1998	1.2096	1.2164	1.2236	(40)
HLP (average)												1.2129	
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											2.5905	(42)
Hot water usage for mixer showers												
	67.6544	66.6377	65.1561	62.3215	60.2295	57.8966	56.5706	58.0410	59.6527	62.1575	65.0531	67.3952 (42a)
Hot water usage for baths												
	29.2168	28.7829	28.1719	27.0452	26.2016	25.2662	24.7609	25.3677	26.0283	27.0293	28.1791	29.1181 (42b)
Hot water usage for other uses												
	41.1596	39.6629	38.1662	36.6695	35.1728	33.6760	33.6760	35.1728	36.6695	38.1662	39.6629	41.1596 (42c)
Average daily hot water use (litres/day)												126.8815 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	138.0308	135.0835	131.4942	126.0362	121.6039	116.8389	115.0076	118.5814	122.3505	127.3530	132.8951	137.6729	(44)
Energy conte	218.6071	192.3571	202.1017	172.5372	163.7022	143.6670	139.0917	146.8285	150.8704	172.8168	189.3335	215.5624	(45)
Energy content (annual)										Total = Sum(45)m =		2107.4758	
Distribution loss (46)m = 0.15 x (45)m													
	32.7911	28.8536	30.3153	25.8806	24.5553	21.5501	20.8638	22.0243	22.6306	25.9225	28.4000	32.3344	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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													
	267.8498	236.8344	251.3444	220.1914	212.9449	191.3212	188.3344	196.0712	198.5246	222.0595	236.9877	264.8051	(62)
WWHRS	-30.9288	-27.3537	-28.6432	-23.7177	-22.1040	-18.9146	-17.7294	-18.8534	-19.5697	-23.0706	-26.1362	-30.3560	(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													
	236.9210	209.4807	222.7012	196.4737	190.8409	172.4066	170.6050	177.2178	178.9549	198.9889	210.8515	234.4491	(64)
										Total per year (kWh/year) = Sum(64)m =		2399.8913	(64)
12Total per year (kWh/year)												2400	(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													
	112.0810	99.5405	106.5929	95.4920	93.8251	85.8926	85.6421	88.2146	88.2878	96.8557	101.0767	111.0686	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	129.5265	(66)

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

	118.2675	130.9390	118.2675	122.2097	118.2675	122.2097	118.2675	118.2675	122.2097	118.2675	122.2097	118.2675	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	234.4785	236.9116	230.7802	217.7270	201.2497	185.7634	175.4176	172.9844	179.1159	192.1691	208.6463	224.1327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	35.9526	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000		(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	-103.6212	(71)
Water heating gains (Table 5)													
	150.6465	148.1258	143.2701	132.6278	126.1090	119.2953	115.1104	118.5680	122.6219	130.1824	140.3844	149.2858	(72)
Total internal gains													
	568.2504	580.8343	557.1757	537.4224	510.4842	489.1264	470.6534	471.6779	485.8055	505.4769	536.0984	556.5439	(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	8.3000	10.6334	0.6300	0.7000	0.7700	26.9725	(74)
South	13.5800	46.7521	0.6300	0.7000	0.7700	194.0316	(78)

Solar gains	221.0041	369.3196	492.3764	598.1881	666.2638	661.6881	637.6974	585.6194	528.1586	404.1074	263.2677	190.1468	(83)
Total gains	789.2545	950.1540	1049.5521	1135.6105	1176.7479	1150.8145	1108.3508	1057.2973	1013.9641	909.5843	799.3660	746.6906	(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	77.3465	77.5938	77.8377	79.0040	79.2261	80.2767	80.2767	80.4744	79.8688	79.2261	78.7781	78.3151	
alpha	6.1564	6.1729	6.1892	6.2669	6.2817	6.3518	6.3518	6.3650	6.3246	6.2817	6.2519	6.2210	
util living area													
	0.9966	0.9890	0.9704	0.9095	0.7755	0.5733	0.4139	0.4519	0.6881	0.9303	0.9901	0.9975	(86)
MIT	20.0469	20.2547	20.4932	20.7648	20.9326	20.9915	20.9991	20.9984	20.9747	20.7618	20.3574	20.0169	(87)
Th 2	19.8890	19.8921	19.8952	19.9096	19.9124	19.9250	19.9250	19.9274	19.9201	19.9124	19.9069	19.9011	(88)
util rest of house													
	0.9951	0.9843	0.9578	0.8746	0.7065	0.4811	0.3134	0.3475	0.5929	0.8949	0.9850	0.9964	(89)
MIT 2	18.8084	19.0734	19.3714	19.6990	19.8666	19.9216	19.9248	19.9270	19.9080	19.7062	19.2168	18.7795	(90)
Living area fraction									fLA = Living area / (4) =			0.3441	(91)
MIT	19.2345	19.4799	19.7574	20.0657	20.2334	20.2897	20.2944	20.2957	20.2750	20.0694	19.6093	19.2052	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2345	19.4799	19.7574	20.0657	20.2334	20.2897	20.2944	20.2957	20.2750	20.0694	19.6093	19.2052	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9938	0.9821	0.9559	0.8802	0.7281	0.5129	0.3480	0.3835	0.6255	0.9009	0.9832	0.9954	(94)
Useful gains	784.3860	933.1145	1003.2208	999.6187	856.8223	590.2023	385.7556	405.5249	634.1862	819.4669	785.9078	743.2847	(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													
	1619.7665	1576.2623	1428.7915	1185.6031	903.5554	594.5690	386.0658	406.0917	648.5782	1002.6658	1332.0728	1607.3076	(97)
Space heating kWh													
	621.5231	432.1953	316.6246	133.9088	34.7694	0.0000	0.0000	0.0000	0.0000	136.3000	393.2388	642.8330	(98a)
Space heating requirement - total per year (kWh/year)												2711.3930	
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													
	621.5231	432.1953	316.6246	133.9088	34.7694	0.0000	0.0000	0.0000	0.0000	136.3000	393.2388	642.8330	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2711.3930	
Space heating per m2											(98c) / (4) =	30.9732	(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													
	621.5231	432.1953	316.6246	133.9088	34.7694	0.0000	0.0000	0.0000	0.0000	136.3000	393.2388	642.8330	(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)													
	673.3728	468.2506	343.0386	145.0799	37.6700	0.0000	0.0000	0.0000	0.0000	147.6707	426.0442	696.4605	(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													
	236.9210	209.4807	222.7012	196.4737	190.8409	172.4066	170.6050	177.2178	178.9549	198.9889	210.8515	234.4491	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.1194	85.6466	84.8486	83.2185	81.0662	79.8000	79.8000	79.8000	79.8000	83.2291	85.4367	86.2018	(217)
Fuel for water heating, kWh/month													
	275.1076	244.5873	262.4690	236.0937	235.4136	216.0484	213.7907	222.0774	224.2542	239.0857	246.7925	271.9769	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	24.5736	19.7139	17.7502	13.0045	10.0451	8.2069	9.1635	11.9110	15.4712	20.2991	22.9278	25.2566	(232)

Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-23.2214	-34.2792	-51.5627	-60.7509	-67.9278	-64.2729	-63.4713	-58.7103	-50.7488	-40.3963	-26.0654	-19.8993 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-8.8226	-18.9242	-38.3057	-58.5668	-78.4685	-79.2344	-78.3192	-65.8543	-47.6589	-27.4183	-11.8910	-6.9510 (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	2937.5872	(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	2887.6971	(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)	198.3234	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1081.7210	(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	5027.8867	(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	2937.5872	0.2100	616.8933	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2887.6971	0.2100	606.4164	(264)
Space and water heating			1223.3097	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	198.3234	0.1443	28.6242	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-561.3061	0.1336	-75.0110	
PV Unit electricity exported	-520.4149	0.1254	-65.2453	
Total			-140.2563	(269)
Total CO2, kg/year			1123.6069	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.8400	(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	2937.5872	1.1300	3319.4736	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2887.6971	1.1300	3263.0977	(278)
Space and water heating			6582.5713	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	198.3234	1.5338	304.1950	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-561.3061	1.4938	-838.5038	
PV Unit electricity exported	-520.4149	0.4602	-239.4817	
Total			-1077.9855	(283)
Total Primary energy kWh/year			5938.8815	(286)
Target Primary Energy Rate (TPER)			67.8400	(287)

Full SAP Calculation Printout

Property Reference	Unit 03	**Issued on Date**	27/02/2025
Assessment Reference	Be Green	**Prop Type Ref**	
Property	3, Frognal Lane, London, NW3 7DY		

SAP Rating	83 B	**DER**	4.51	**TER**	13.88
Environmental	97 A	**% DER < TER**			67.51
CO_2 Emissions (t/year)	0.26	**DFEE**	35.88	**TFEE**	34.74
Compliance Check	See BREL	**% DFEE < TFEE**			-3.29
% DPER < TPER	34.66	**DPER**	48.18	**TPER**	73.73

Assessor Details	Mr. Maximus Cunningham	**Assessor ID**	DG68-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	60.7700	(1b)	x 2.6000	(2b) =	158.0020	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.7700					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	158.0020	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		2.0000	(17)
Infiltration rate		0.1000	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1000	(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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2270	0.2245	0.2220	0.2095	0.2070	0.1945	0.1945	0.1920	0.1995	0.2070	0.2120	0.2170	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			9.3200	0.9615	8.9615			(27)
FG Doors			2.2500	0.9615	2.1635			(27)
External Wall 1	47.6300	11.5700	36.0600	0.1600	5.7696	150.0000	5409.0000	(29a)
Wall to Corridor	19.6800		19.6800	0.1600	3.1488	150.0000	2952.0000	(29a)
Wall to Garage	15.5200		15.5200	0.1600	2.4832	150.0000	2328.0000	(29a)
Total net area of external elements Aum(A, m2)			82.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		22.5266			(33)
Main dwelling								
Party Wall 1			27.3300	0.0000	0.0000	70.0000	1913.1000	(32)
Party Floor 1			60.7700			80.0000	4861.6000	(32d)
Party Ceiling 1			60.7700			100.0000	6077.0000	(32b)
Internal Wall 1			90.0100			9.0000	810.0900	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 24350.7900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	400.7041	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E16 Corner (normal)	7.8000	0.0370	0.2886
E17 Corner (inverted - internal area greater than external area)	5.2000	-0.0790	-0.4108
E7 Party floor between dwellings (in blocks of flats)	40.2400	0.0360	1.4486
E7 Party floor between dwellings (in blocks of flats)	27.0800	0.2800	7.5824
E16 Corner (normal)	7.8000	0.1800	1.4040
E2 Other lintels (including other steel lintels)	8.0400	0.2210	1.7768
E3 Sill	6.9700	0.0240	0.1673
E4 Jamb	17.1000	0.0190	0.3249

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.5819 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.1085 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	11.8359	11.7056	11.5752	10.9235	10.7931	10.1414	10.1414	10.0110	10.4021	10.7931	11.0538	11.3145	(38)

Heat transfer coeff

	46.9444	46.8140	46.6837	46.0319	45.9016	45.2498	45.2498	45.1195	45.5105	45.9016	46.1623	46.4230	(39)

Average = Sum(39)m / 12 = 45.9993

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7725	0.7703	0.7682	0.7575	0.7553	0.7446	0.7446	0.7425	0.7489	0.7553	0.7596	0.7639	(40)
HLP (average)												0.7569	
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 2.0033 (42)

Hot water usage for mixer showers

	57.8087	56.9399	55.6740	53.2518	51.4643	49.4709	48.3379	49.5943	50.9715	53.1118	55.5859	57.5872	(42a)

Hot water usage for baths

	24.9828	24.6118	24.0893	23.1260	22.4046	21.6047	21.1727	21.6915	22.2564	23.1123	24.0955	24.8984	(42b)

Hot water usage for other uses

	35.1460	33.8680	32.5899	31.3119	30.0339	28.7558	28.7558	30.0339	31.3119	32.5899	33.8680	35.1460	(42c)

Average daily hot water use (litres/day) 108.4116 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.9375	115.4197	112.3532	107.6897	103.9028	99.8315	98.2664	101.3196	104.5398	108.8140	113.5494	117.6316	(44)
Energy conte	186.7842	164.3561	172.6827	147.4218	139.8731	122.7544	118.8447	125.4548	128.9080	147.6596	161.7720	184.1826	(45)
Energy content (annual)											Total = Sum(45)m =	1800.6938	

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

	28.0176	24.6534	25.9024	22.1133	20.9810	18.4132	17.8267	18.8182	19.3362	22.1489	24.2658	27.6274	(46)

Water storage loss:

Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8800 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0152 (55)

Total storage loss

	31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(56)

If cylinder contains dedicated solar storage

	31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(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

	241.5178	213.7929	227.4163	200.3898	194.6067	175.7224	173.5783	180.1884	181.8760	202.3932	214.7400	238.9162	(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

	241.5178	213.7929	227.4163	200.3898	194.6067	175.7224	173.5783	180.1884	181.8760	202.3932	214.7400	238.9162	(64)
											Total per year (kWh/year) = Sum(64)m =	2445.1378	(64)
12Total per year (kWh/year)												2445	(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

	105.8926	94.1978	101.2039	91.3921	90.2947	83.1903	83.3027	85.5006	85.2363	92.8837	96.1636	105.0276	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	(66)

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

	89.3534	98.9269	89.3534	92.3318	89.3534	92.3318	89.3534	89.3534	92.3318	89.3534	92.3318	89.3534	(67)

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

	174.8846	176.6994	172.1263	162.3906	150.1011	138.5507	130.8344	129.0196	133.5927	143.3284	155.6179	167.1683	(68)

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

	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	(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)

	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	(71)

Water heating gains (Table 5)

	142.3288	140.1754	136.0267	126.9335	121.3638	115.5420	111.9660	114.9202	118.3838	124.8437	133.5605	141.1661	(72)

Total internal gains

	459.6166	468.8515	450.5562	434.7058	413.8681	399.4744	385.2036	386.3429	397.3581	410.5752	434.5600	450.7375	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.2000	10.6334	0.4000	0.7000	0.7700	14.8558	(74)
South	2.1200	46.7521	0.4000	0.7000	0.7700	19.2322	(78)
North	2.2500	10.6334	0.4000	0.7000	0.7700	4.6424	(74)

Solar gains	38.7304	68.7594	103.4394	147.0505	184.2585	192.1429	181.3651	151.7886	118.0402	78.3285	46.8502	32.8730	(83)
Total gains	498.3470	537.6109	553.9955	581.7563	598.1266	591.6173	566.5687	538.1316	515.3983	488.9036	481.4102	483.6106	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	144.0877	144.4889	144.8923	146.9438	147.3611	149.4837	149.4837	149.9155	148.6274	147.3611	146.5289	145.7060	
alpha	10.6058	10.6326	10.6595	10.7963	10.8241	10.9656	10.9656	10.9944	10.9085	10.8241	10.7686	10.7137	
util living area	0.9970	0.9919	0.9763	0.8939	0.7083	0.4894	0.3514	0.3857	0.6082	0.9041	0.9883	0.9977	(86)
Living	20.7008	20.7635	20.8428	20.9363	20.9681	20.9715	20.9715	20.9716	20.9709	20.9379	20.8149	20.6911	
Non living	19.9333	20.0139	20.1128	20.2244	20.2534	20.2651	20.2651	20.2671	20.2609	20.2293	20.0870	19.9278	
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	20.8469	20.7635	20.8428	20.9363	20.9681	20.9715	20.9715	20.9716	20.9709	20.9379	20.8149	20.7343	(87)
Th 2	20.2772	20.2791	20.2810	20.2903	20.2922	20.3016	20.3016	20.3035	20.2978	20.2922	20.2885	20.2847	(88)
util rest of house	0.9956	0.9883	0.9658	0.8603	0.6569	0.4361	0.2956	0.3273	0.5469	0.8661	0.9822	0.9966	(89)
MIT 2	20.1401	20.0139	20.1128	20.2244	20.2534	20.2651	20.2651	20.2671	20.2609	20.2293	20.0870	19.9921	(90)
Living area fraction										fLA = Living area / (4) =		0.3370	(91)
MIT	20.3783	20.2665	20.3588	20.4644	20.4943	20.5031	20.5032	20.5045	20.5002	20.4681	20.3323	20.2422	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3783	20.2665	20.3588	20.4644	20.4943	20.5031	20.5032	20.5045	20.5002	20.4681	20.3323	20.2422	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9958	0.9882	0.9671	0.8691	0.6718	0.4515	0.3117	0.3441	0.5647	0.8764	0.9826	0.9965	(94)
Useful gains	496.2574	531.2563	535.7802	505.6148	401.7929	267.0920	176.6174	185.1920	291.0248	428.4550	473.0497	481.9385	(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	754.7871	719.3681	646.9793	532.3296	403.6716	267.1159	176.6177	185.1929	291.2758	452.9608	610.8345	744.7279	(97)
Space heating kWh	192.3461	126.4112	82.7321	19.2347	1.3978	0.0000	0.0000	0.0000	0.0000	18.2323	99.2050	195.5154	(98a)
Space heating requirement - total per year (kWh/year)												735.0745	
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	192.3461	126.4112	82.7321	19.2347	1.3978	0.0000	0.0000	0.0000	0.0000	18.2323	99.2050	195.5154	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												735.0745	
Space heating per m2											(98c) / (4) =	12.0960	(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 %) 304.5721 (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	192.3461	126.4112	82.7321	19.2347	1.3978	0.0000	0.0000	0.0000	0.0000	18.2323	99.2050	195.5154	(98)
Space heating efficiency (main heating system 1)	304.5721	304.5721	304.5721	304.5721	304.5721	0.0000	0.0000	0.0000	0.0000	304.5721	304.5721	304.5721	(210)
Space heating fuel (main heating system)	63.1529	41.5045	27.1634	6.3153	0.4589	0.0000	0.0000	0.0000	0.0000	5.9862	32.5719	64.1935	(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	241.5178	213.7929	227.4163	200.3898	194.6067	175.7224	173.5783	180.1884	181.8760	202.3932	214.7400	238.9162	(64)
Efficiency of water heater												182.2893	(216)
(217)m	182.2893	182.2893	182.2893	182.2893	182.2893	182.2893	182.2893	182.2893	182.2893	182.2893	182.2893	182.2893	(217)
Fuel for water heating, kWh/month	132.4915	117.2822	124.7557	109.9295	106.7571	96.3976	95.2213	98.8475	99.7733	111.0286	117.8017	131.0643	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	12.6880	11.4601	12.6880	12.2787	12.6880	12.2787	12.6880	12.6880	12.2787	12.6880	12.2787	12.6880	(231)
Lighting	22.5417	18.0838	16.2824	11.9292	9.2145	7.5283	8.4057	10.9261	14.1919	18.6206	21.0319	23.1682	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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 1 241.3466 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 182.2893

Water heating fuel used 1341.3503 (219)

Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7750)		
mechanical ventilation fans (SFP = 0.7750)	149.3909	(230a)
Total electricity for the above, kWh/year	149.3909	(231)
Electricity for lighting (calculated in Appendix L)	181.9241	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(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	1914.0119	(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	241.3466	0.1585	38.2503	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1341.3503	0.1408	188.8927	(264)
Space and water heating			227.1430	(265)
Pumps, fans and electric keep-hot	149.3909	0.1387	20.7224	(267)
Energy for lighting	181.9241	0.1443	26.2573	(268)
Total CO2, kg/year			274.1227	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.5100	(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	241.3466	1.5867	382.9413	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1341.3503	1.5207	2039.8020	(278)
Space and water heating			2422.7433	(279)
Pumps, fans and electric keep-hot	149.3909	1.5128	225.9985	(281)
Energy for lighting	181.9241	1.5338	279.0413	(282)
Total Primary energy kWh/year			2927.7832	(286)
Dwelling Primary energy Rate (DPER)			48.1800	(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		60.7700 (1b)	x	2.6000 (2b)	=	158.0020	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.7700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	158.0020	(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	2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1266	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3766	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3766	(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	0.4801	0.4707	0.4613	0.4142	0.4048	0.3578	0.3578	0.3483	0.3766	0.4048	0.4237	0.4425	(22b)
Effective ac	0.6153	0.6108	0.6064	0.5858	0.5819	0.5640	0.5640	0.5607	0.5709	0.5819	0.5897	0.5979	(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 Opening Type			11.5700	1.1450	13.2481			(27)
External Wall 1	47.6300	11.5700	36.0600	0.1800	6.4908			(29a)
Wall to Corridor	19.6800		19.6800	0.1800	3.5424			(29a)
Wall to Garage	15.5200		15.5200	0.1800	2.7936			(29a)
Total net area of external elements Aum(A, m2)			82.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.0749			(33)
Main dwelling								
Party Wall 1			27.3300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 380.7041 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E16 Corner (normal)	7.8000	0.0900	0.7020	
E17 Corner (inverted - internal area greater than external area)	5.2000	-0.0900	-0.4680	
E7 Party floor between dwellings (in blocks of flats)	40.2400	0.0700	2.8168	
E7 Party floor between dwellings (in blocks of flats)	27.0800	0.0700	1.8956	
E16 Corner (normal)	7.8000	0.0900	0.7020	
E2 Other lintels (including other steel lintels)	8.0400	0.0500	0.4020	
E3 Sill	6.9700	0.0500	0.3485	
E4 Jamb	17.1000	0.0500	0.8550	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.2539 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 33.3288 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	32.0804	31.8471	31.6183	30.5438	30.3428	29.4070	29.4070	29.2337	29.7674	30.3428	30.7495	31.1747	(38)
Heat transfer coeff	65.4092	65.1759	64.9471	63.8726	63.6716	62.7358	62.7358	62.5625	63.0962	63.6716	64.0783	64.5034	(39)
Average = Sum(39)m / 12 =												63.8717	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0763	1.0725	1.0687	1.0511	1.0477	1.0323	1.0323	1.0295	1.0383	1.0477	1.0544	1.0614	(40)
HLP (average)												1.0510	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.0033 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	57.8087	56.9399	55.6740	53.2518	51.4643	49.4709	48.3379	49.5943	50.9715	53.1118	55.5859	57.5872	(42a)
Hot water usage for baths	24.9828	24.6118	24.0893	23.1260	22.4046	21.6047	21.1727	21.6915	22.2564	23.1123	24.0955	24.8984	(42b)
Hot water usage for other uses	35.1460	33.8680	32.5899	31.3119	30.0339	28.7558	28.7558	30.0339	31.3119	32.5899	33.8680	35.1460	(42c)
Average daily hot water use (litres/day)												108.4116	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.9375	115.4197	112.3532	107.6897	103.9028	99.8315	98.2664	101.3196	104.5398	108.8140	113.5494	117.6316	(44)
Energy conte	186.7842	164.3561	172.6827	147.4218	139.8731	122.7544	118.8447	125.4548	128.9080	147.6596	161.7720	184.1826	(45)
Energy content (annual)										Total = Sum(45)m =		1800.6938	
Distribution loss (46)m = 0.15 x (45)m	28.0176	24.6534	25.9024	22.1133	20.9810	18.4132	17.8267	18.8182	19.3362	22.1489	24.2658	27.6274	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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	236.0268	208.8333	221.9254	195.0760	189.1158	170.4086	168.0873	174.6975	176.5622	196.9022	209.4262	233.4253	(62)
WWHRS	-26.4277	-23.3729	-24.4747	-20.2660	-18.8872	-16.1619	-15.1492	-16.1097	-16.7218	-19.7131	-22.3326	-25.9383	(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	209.5991	185.4605	197.4507	174.8099	170.2285	154.2467	152.9381	158.5878	159.8404	177.1891	187.0936	207.4870	(64)
										Total per year (kWh/year) = Sum(64)m =		2134.9314	(64)
12Total per year (kWh/year)												2135	(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	101.4999	90.2302	96.8111	87.1411	85.9019	78.9392	78.9100	81.1079	80.9853	88.4909	91.9125	100.6348	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	100.1660	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	89.3534	98.9269	89.3534	92.3318	89.3534	92.3318	89.3534	89.3534	92.3318	89.3534	92.3318	89.3534	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	174.8846	176.6994	172.1263	162.3906	150.1011	138.5507	130.8344	129.0196	133.5927	143.3284	155.6179	167.1683	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	33.0166	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	-80.1328	(71)
Water heating gains (Table 5)	136.4246	134.2711	130.1225	121.0293	115.4596	109.6378	106.0618	109.0160	112.4795	118.9394	127.6563	135.2619	(72)
Total internal gains	456.7124	465.9473	447.6519	431.8015	410.9639	393.5701	379.2993	380.4387	391.4539	407.6710	431.6558	447.8333	(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	9.4500	10.6334	0.6300	0.7000	0.7700	30.7097	(74)
South	2.1200	46.7521	0.6300	0.7000	0.7700	30.2906	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	61.0003	108.2961	162.9170	231.6046	290.2071	302.6251	285.6500	239.0671	185.9133	123.3673	73.7891	51.7750	(83)
Total gains	517.7127	574.2433	610.5690	663.4061	701.1710	696.1952	664.9494	619.5058	577.3672	531.0383	505.4449	499.6083	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	98.2506	98.6024	98.9497	100.6143	100.9319	102.4375	102.4375	102.7213	101.8523	100.9319	100.2914	99.6303	
alpha	7.5500	7.5735	7.5966	7.7076	7.7288	7.8292	7.8292	7.8481	7.7902	7.7288	7.6861	7.6420	
util living area	0.9981	0.9953	0.9866	0.9407	0.7984	0.5734	0.4149	0.4639	0.7316	0.9579	0.9944	0.9985	(86)
MIT	20.2747	20.3976	20.5720	20.8119	20.9591	20.9971	20.9998	20.9995	20.9836	20.8058	20.5096	20.2617	(87)
Th 2	20.0202	20.0234	20.0264	20.0410	20.0437	20.0565	20.0565	20.0588	20.0516	20.0437	20.0382	20.0325	(88)
util rest of house	0.9972	0.9930	0.9799	0.9137	0.7341	0.4907	0.3261	0.3694	0.6422	0.9324	0.9912	0.9978	(89)
MIT 2	19.1924	19.3512	19.5729	19.8699	20.0169	20.0554	20.0564	20.0587	20.0439	19.8715	19.5062	19.1856	(90)
Living area fraction									fLA = Living area / (4) =			0.3370	(91)
MIT	19.5571	19.7039	19.9096	20.1874	20.3344	20.3727	20.3743	20.3758	20.3606	20.1864	19.8444	19.5483	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5571	19.7039	19.9096	20.1874	20.3344	20.3727	20.3743	20.3758	20.3606	20.1864	19.8444	19.5483	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9920	0.9789	0.9184	0.7547	0.5187	0.3560	0.4013	0.6725	0.9370	0.9903	0.9973	(94)
Useful gains	515.9503	569.6229	597.6687	609.2905	529.1934	361.1119	236.7396	248.6194	388.2941	497.5868	500.5469	498.2750	(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	997.9567	964.8547	870.9150	720.9533	549.7674	362.1570	236.7866	248.7350	395.0194	610.3794	816.6375	990.0156	(97)
Space heating kWh	358.6128	265.5958	203.2953	80.3972	15.3070	0.0000	0.0000	0.0000	0.0000	83.9177	227.5853	365.8551	(98a)
Space heating requirement - total per year (kWh/year)												1600.5660	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	358.6128	265.5958	203.2953	80.3972	15.3070	0.0000	0.0000	0.0000	0.0000	83.9177	227.5853	365.8551	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1600.5660	
Space heating per m2											(98c) / (4) =	26.3381	(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	358.6128	265.5958	203.2953	80.3972	15.3070	0.0000	0.0000	0.0000	0.0000	83.9177	227.5853	365.8551	(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)	388.5295	287.7527	220.2549	87.1043	16.5840	0.0000	0.0000	0.0000	0.0000	90.9184	246.5713	396.3760	(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	209.5991	185.4605	197.4507	174.8099	170.2285	154.2467	152.9381	158.5878	159.8404	177.1891	187.0936	207.4870	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2533	84.8646	84.1253	82.4319	80.4729	79.8000	79.8000	79.8000	79.8000	82.4869	84.5002	85.3178	(217)
Fuel for water heating, kWh/month	245.8547	218.5369	234.7102	212.0658	211.5353	193.2916	191.6517	198.7316	200.3013	214.8088	221.4119	243.1931	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	18.5659	14.8942	13.4106	9.8252	7.5893	6.2005	6.9232	8.9990	11.6888	15.3363	17.3224	19.0819	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-16.3660	-24.2925	-36.7464	-43.5584	-48.9549	-46.4358	-45.8818	-42.3324	-36.4132	-28.7641	-18.4246	-14.0115	(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	-5.8788	-12.6411	-25.6400	-39.2716	-52.6730	-53.1865	-52.5487	-44.1400	-31.9011	-18.3126	-7.9247	-4.6278	(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	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1734.0910	(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	2586.0929	(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)	149.8372	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-750.9274	(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	3805.0937	(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	1734.0910	0.2100	364.1591	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2586.0929	0.2100	543.0795	(264)
Space and water heating			907.2386	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	149.8372	0.1443	21.6261	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-402.1815	0.1335	-53.6943	
PV Unit electricity exported	-348.7458	0.1253	-43.7089	
Total			-97.4032	(269)
Total CO2, kg/year			843.3909	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.8800	(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	1734.0910	1.1300	1959.5229	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2586.0929	1.1300	2922.2850	(278)
Space and water heating			4881.8079	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	149.8372	1.5338	229.8252	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-402.1815	1.4934	-600.6018	
PV Unit electricity exported	-348.7458	0.4600	-160.4325	
Total			-761.0342	(283)
Total Primary energy kWh/year			4480.6997	(286)
Target Primary Energy Rate (TPER)			73.7300	(287)

Full SAP Calculation Printout

Property Reference	Unit 07	**Issued on Date**	27/02/2025
Assessment Reference	Be Green	**Prop Type Ref**	
Property	3, Frognal Lane, London, NW3 7DY		

SAP Rating	84 B	**DER**	3.63	**TER**	11.30
Environmental	97 A	**% DER < TER**			67.88
CO_2 Emissions (t/year)	0.32	**DFEE**	30.96	**TFEE**	32.46
Compliance Check	See BREL	**% DFEE < TFEE**			4.61
% DPER < TPER	35.01	**DPER**	38.72	**TPER**	59.58

Assessor Details	Mr. Maximus Cunningham	**Assessor ID**	DG68-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	92.6000	(1b)	x 1.9600	(2b) =	181.4960	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.6000					
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	181.4960	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		2.0000	(17)
Infiltration rate		0.1000	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1000	(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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000 (23c)

Effective ac	0.2090	0.2065	0.2040	0.1915	0.1890	0.1765	0.1765	0.1740	0.1815	0.1890	0.1940	0.1990	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			12.9100	0.9615	12.4135			(27)
FG Doors			10.0800	0.9615	9.6923			(27)
External Wall 1	60.9600	22.9900	37.9700	0.1600	6.0752	150.0000	5695.5000	(29a)
Wall to Corridor	23.1500		23.1500	0.1600	3.7040	150.0000	3472.5000	(29a)
Flat Roof	46.4000		46.4000	0.1000	4.6400	9.0000	417.6000	(30)
Slope Roof	54.0200		54.0200	0.1000	5.4020	9.0000	486.1800	(30)
Total net area of external elements Aum(A, m2)			184.5300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.9270			(33)
Main dwelling								
Party Floor 1			92.6000			80.0000	7408.0000	(32d)
Internal Wall 1			67.8900			9.0000	611.0100	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18090.7900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	195.3649 (35)
List of Thermal Bridges	

	Length	Psi-value	Total	
K1 Element				
E16 Corner (normal)	5.0000	0.0370	0.1850	
E7 Party floor between dwellings (in blocks of flats)	28.5100	0.0360	1.0264	
E7 Party floor between dwellings (in blocks of flats)	9.5700	0.2800	2.6796	
E16 Corner (normal)	10.0000	0.1800	1.8000	
E2 Other lintels (including other steel lintels)	14.0500	0.2210	3.1051	
E3 Sill	14.0500	0.0240	0.3372	
E4 Jamb	36.2400	0.0190	0.6886	
E14 Flat roof	19.3400	0.1600	3.0944	
E13 Gable (insulation at rafter level)	9.6500	0.0280	0.2702	
E11 Eaves (insulation at rafter level)	10.2800	0.0180	0.1850	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			13.3714	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	55.2984	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	12.5178	12.3680	12.2183	11.4696	11.3199	10.5712	10.5712	10.4215	10.8707	11.3199	11.6194	11.9188	(38)
Heat transfer coeff	67.8162	67.6664	67.5167	66.7680	66.6183	65.8696	65.8696	65.7199	66.1691	66.6183	66.9178	67.2172	(39)
Average = Sum(39)m / 12 =												66.7306	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7324	0.7307	0.7291	0.7210	0.7194	0.7113	0.7113	0.7097	0.7146	0.7194	0.7227	0.7259	(40)
HLP (average)												0.7206	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6597	(42)
Hot water usage for mixer showers	68.8136	67.7794	66.2725	63.3892	61.2615	58.8886	57.5399	59.0354	60.6748	63.2225	66.1677	68.5499	(42a)
Hot water usage for baths	29.7153	29.2740	28.6525	27.5067	26.6486	25.6973	25.1834	25.8005	26.4724	27.4904	28.6599	29.6148	(42b)
Hot water usage for other uses	41.8676	40.3451	38.8227	37.3002	35.7778	34.2553	34.2553	35.7778	37.3002	38.8227	40.3451	41.8676	(42c)
Average daily hot water use (litres/day)												129.0560	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	140.3964	137.3985	133.7477	128.1961	123.6879	118.8412	116.9785	120.6136	124.4474	129.5356	135.1727	140.0323	(44)
Energy conte	222.3537	195.6537	205.5652	175.4941	166.5077	146.1291	141.4754	149.3449	153.4561	175.7786	192.5783	219.2568	(45)
Energy content (annual)											Total = Sum(45)m =	2143.5934	
Distribution loss (46)m = 0.15 x (45)m	33.3530	29.3481	30.8348	26.3241	24.9761	21.9194	21.2213	22.4017	23.0184	26.3668	28.8867	32.8885	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0152	(55)
Total storage loss	31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(56)
If cylinder contains dedicated solar storage	31.4712	28.4256	31.4712	30.4560	31.4712	30.4560	31.4712	31.4712	30.4560	31.4712	30.4560	31.4712	(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	277.0873	245.0905	260.2988	228.4621	221.2413	199.0971	196.2090	204.0785	206.4241	230.5122	245.5463	273.9904	(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	277.0873	245.0905	260.2988	228.4621	221.2413	199.0971	196.2090	204.0785	206.4241	230.5122	245.5463	273.9904	(64)
										Total per year (kWh/year) = Sum(64)m =		2788.0374	(64)
12Total per year (kWh/year)												2788	(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	117.7195	104.6043	112.1373	100.7262	99.1507	90.9623	90.8274	93.4440	93.3985	102.2333	106.4067	116.6898	(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	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	122.9593	136.1335	122.9593	127.0579	122.9593	127.0579	122.9593	122.9593	127.0579	122.9593	127.0579	122.9593	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.7806	246.3102	239.9355	226.3645	209.2336	193.1329	182.3766	179.8470	186.2217	199.7927	216.9236	233.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	(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)	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	(71)
Water heating gains (Table 5)	158.2251	155.6611	150.7222	139.8975	133.2670	126.3365	122.0799	125.5968	129.7202	137.4103	147.7871	156.8411	(72)
Total internal gains	587.8599	600.9998	576.5119	556.2149	528.3548	509.4223	490.3108	491.2980	505.8947	523.0572	554.6636	575.7196	(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	7.2900	10.6334	0.4000	0.7000	0.7700	15.0415	(74)
South	5.6200	46.7521	0.4000	0.7000	0.7700	50.9834	(78)
North	4.6200	10.6334	0.4000	0.7000	0.7700	9.5325	(74)
East	2.7300	19.6403	0.4000	0.7000	0.7700	10.4040	(76)

West			2.7300		19.6403		0.4000		0.7000		0.7700		10.4040 (80)
Solar gains	96.3653	171.1646	253.1964	346.1574	417.7537	428.0545	407.1380	351.6124	285.0170	194.2620	116.6930	81.6519	(83)
Total gains	684.2252	772.1644	829.7083	902.3722	946.1086	937.4768	897.4487	842.9104	790.9117	717.3192	671.3565	657.3715	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.1006	74.2646	74.4293	75.2639	75.4330	76.2904	76.2904	76.4642	75.9451	75.4330	75.0955	74.7609	
alpha	5.9400	5.9510	5.9620	6.0176	6.0289	6.0860	6.0860	6.0976	6.0630	6.0289	6.0064	5.9841	
util living area	0.9795	0.9587	0.9169	0.8060	0.6363	0.4478	0.3227	0.3582	0.5684	0.8424	0.9563	0.9832	(86)
Living	20.4134	20.5441	20.6955	20.8551	20.9282	20.9469	20.9487	20.9486	20.9406	20.8458	20.6145	20.3891	
Non living	19.6244	19.7883	19.9739	20.1640	20.2405	20.2640	20.2653	20.2667	20.2566	20.1589	19.8837	19.5987	
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	20.6999	20.5441	20.6955	20.8551	20.9282	20.9469	20.9487	20.9486	20.9406	20.8458	20.6145	20.4745	(87)
Th 2	20.3123	20.3138	20.3152	20.3223	20.3237	20.3308	20.3308	20.3323	20.3280	20.3237	20.3209	20.3180	(88)
util rest of house	0.9752	0.9505	0.9014	0.7765	0.5951	0.4017	0.2738	0.3064	0.5162	0.8105	0.9463	0.9796	(89)
MIT 2	20.0381	19.7883	19.9739	20.1640	20.2405	20.2640	20.2653	20.2667	20.2566	20.1589	19.8837	19.7283	(90)
Living area fraction										fLA = Living area / (4) =		0.3563	(91)
MIT	20.2739	20.0575	20.2310	20.4102	20.4855	20.5073	20.5088	20.5097	20.5003	20.4036	20.1441	19.9941	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2739	20.0575	20.2310	20.4102	20.4855	20.5073	20.5088	20.5097	20.5003	20.4036	20.1441	19.9941	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9749	0.9470	0.8993	0.7805	0.6051	0.4139	0.2868	0.3202	0.5298	0.8146	0.9433	0.9776	(94)
Useful gains	667.0668	731.2422	746.1430	704.3365	572.5013	388.0316	257.3770	269.9088	418.9872	584.2934	633.2701	642.6357	(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	1083.2859	1025.6560	927.0713	768.5127	585.2753	389.1127	257.4690	270.0866	423.4999	653.1003	872.8796	1061.6388	(97)
Space heating kWh	309.6671	197.8461	134.6106	46.2069	9.5039	0.0000	0.0000	0.0000	0.0000	51.1923	172.5188	311.7383	(98a)
Space heating requirement - total per year (kWh/year)												1233.2840	
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	309.6671	197.8461	134.6106	46.2069	9.5039	0.0000	0.0000	0.0000	0.0000	51.1923	172.5188	311.7383	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1233.2840	
Space heating per m2										(98c) / (4) =		13.3184	(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 %)												342.9017	(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	309.6671	197.8461	134.6106	46.2069	9.5039	0.0000	0.0000	0.0000	0.0000	51.1923	172.5188	311.7383	(98)
Space heating efficiency (main heating system 1)	342.9017	342.9017	342.9017	342.9017	342.9017	0.0000	0.0000	0.0000	0.0000	342.9017	342.9017	342.9017	(210)
Space heating fuel (main heating system)	90.3078	57.6976	39.2563	13.4753	2.7716	0.0000	0.0000	0.0000	0.0000	14.9291	50.3115	90.9118	(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	277.0873	245.0905	260.2988	228.4621	221.2413	199.0971	196.2090	204.0785	206.4241	230.5122	245.5463	273.9904	(64)
Efficiency of water heater												182.0866	(216)
(217)m	182.0866	182.0866	182.0866	182.0866	182.0866	182.0866	182.0866	182.0866	182.0866	182.0866	182.0866	182.0866	(217)
Fuel for water heating, kWh/month	152.1733	134.6010	142.9533	125.4689	121.5033	109.3419	107.7558	112.0777	113.3659	126.5948	134.8514	150.4725	(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	15.5149	14.0135	15.5149	15.0144	15.5149	15.0144	15.5149	15.5149	15.0144	15.5149	15.0144	15.5149	(231)
Lighting	33.1627	26.6044	23.9543	17.5499	13.5561	11.0754	12.3663	16.0742	20.8788	27.3941	30.9416	34.0844	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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												359.6611	(211)
Space heating fuel - main system 2												0.0000	(213)

Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	182.0866	
Water heating fuel used	1531.1598	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	182.6757	(230a)
Total electricity for the above, kWh/year	182.6757	(231)
Electricity for lighting (calculated in Appendix L)	267.6424	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(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	2341.1390	(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	359.6611	0.1576	56.6969	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1531.1598	0.1409	215.7645	(264)
Space and water heating			272.4613	(265)
Pumps, fans and electric keep-hot	182.6757	0.1387	25.3394	(267)
Energy for lighting	267.6424	0.1443	38.6291	(268)
Total CO2, kg/year			336.4298	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.6300	(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	359.6611	1.5835	569.5392	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1531.1598	1.5211	2328.9800	(278)
Space and water heating			2898.5192	(279)
Pumps, fans and electric keep-hot	182.6757	1.5128	276.3518	(281)
Energy for lighting	267.6424	1.5338	410.5188	(282)
Total Primary energy kWh/year			3585.3898	(286)
Dwelling Primary energy Rate (DPER)			38.7200	(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	92.6000 (1b)	x	1.9600 (2b)	=	181.4960 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.6000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	181.4960	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1653	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4153	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4153	(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	0.5295	0.5191	0.5087	0.4568	0.4464	0.3945	0.3945	0.3841	0.4153	0.4464	0.4672	0.4880	(22b)
Effective ac	0.6402	0.6347	0.6294	0.6043	0.5997	0.5778	0.5778	0.5738	0.5862	0.5997	0.6091	0.6191	(25)

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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								
TER Opening Type			22.9900	1.1450	26.3244			(27)
External Wall 1	60.9600	22.9900	37.9700	0.1800	6.8346			(29a)
Wall to Corridor	23.1500		23.1500	0.1800	4.1670			(29a)
Flat Roof	46.4000		46.4000	0.1100	5.1040			(30)
Slope Roof	54.0200		54.0200	0.1100	5.9422			(30)
Total net area of external elements Aum(A, m2)			184.5300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.3722			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 195.3649 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E16 Corner (normal)	5.0000	0.0900	0.4500
E7 Party floor between dwellings (in blocks of flats)	28.5100	0.0700	1.9957
E7 Party floor between dwellings (in blocks of flats)	9.5700	0.0700	0.6699
E16 Corner (normal)	10.0000	0.0900	0.9000
E2 Other lintels (including other steel lintels)	14.0500	0.0500	0.7025
E3 Sill	14.0500	0.0500	0.7025
E4 Jamb	36.2400	0.0500	1.8120
E14 Flat roof	19.3400	0.0800	1.5472
E13 Gable (insulation at rafter level)	9.6500	0.0800	0.7720
E11 Eaves (insulation at rafter level)	10.2800	0.0400	0.4112

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.9630 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 58.3352 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.3430	38.0170	37.6974	36.1963	35.9155	34.6081	34.6081	34.3660	35.1117	35.9155	36.4836	37.0776	(38)
Heat transfer coeff	96.6782	96.3522	96.0326	94.5316	94.2507	92.9434	92.9434	92.7013	93.4469	94.2507	94.8189	95.4128	(39)
Average = Sum(39)m / 12 =												94.5302	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0440	1.0405	1.0371	1.0209	1.0178	1.0037	1.0037	1.0011	1.0091	1.0178	1.0240	1.0304	(40)
HLP (average)												1.0208	
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 2.6597 (42)

Hot water usage for mixer showers

68.8136	67.7794	66.2725	63.3892	61.2615	58.8886	57.5399	59.0354	60.6748	63.2225	66.1677	68.5499	(42a)

Hot water usage for baths

29.7153	29.2740	28.6525	27.5067	26.6486	25.6973	25.1834	25.8005	26.4724	27.4904	28.6599	29.6148	(42b)

Hot water usage for other uses

41.8676	40.3451	38.8227	37.3002	35.7778	34.2553	34.2553	35.7778	37.3002	38.8227	40.3451	41.8676	(42c)

Average daily hot water use (litres/day) 129.0560 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	140.3964	137.3985	133.7477	128.1961	123.6879	118.8412	116.9785	120.6136	124.4474	129.5356	135.1727	140.0323	(44)
Energy conte	222.3537	195.6537	205.5652	175.4941	166.5077	146.1291	141.4754	149.3449	153.4561	175.7786	192.5783	219.2568	(45)
Energy content (annual)										Total = Sum(45)m =		2143.5934	
Distribution loss (46)m = 0.15 x (45)m	33.3530	29.3481	30.8348	26.3241	24.9761	21.9194	21.2213	22.4017	23.0184	26.3668	28.8867	32.8885	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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	271.5963	240.1309	254.8079	223.1483	215.7503	193.7833	190.7181	198.5875	201.1103	225.0213	240.2325	268.4995	(62)
WWHRS	-31.4587	-27.8223	-29.1339	-24.1240	-22.4827	-19.2386	-18.0332	-19.1765	-19.9050	-23.4658	-26.5840	-30.8761	(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	240.1376	212.3086	225.6740	199.0242	193.2676	174.5446	172.6849	179.4111	181.2052	201.5554	213.6486	237.6234	(64)
										Total per year (kWh/year) = Sum(64)m =		2431.0852	(64)
12Total per year (kWh/year)												2431	(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	113.3267	100.6367	107.7446	96.4751	94.7579	86.7113	86.4347	89.0513	89.1475	97.8405	102.1556	112.2970	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	132.9831	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	122.9593	136.1335	122.9593	127.0579	122.9593	127.0579	122.9593	122.9593	127.0579	122.9593	127.0579	122.9593	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.7806	246.3102	239.9355	226.3645	209.2336	193.1329	182.3766	179.8470	186.2217	199.7927	216.9236	233.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	36.2983	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	-106.3865	(71)

Water heating gains (Table 5)

	152.3209	149.7569	144.8180	133.9932	127.3628	120.4323	116.1757	119.6926	123.8160	131.5061	141.8828	150.9369 (72)

Total internal gains

	584.9556	598.0956	573.6077	553.3106	525.4506	503.5181	484.4065	485.3938	499.9905	520.1530	551.7593	572.8154 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.9100	10.6334	0.6300	0.7000	0.7700	38.7040	(74)
East	2.7300	19.6403	0.6300	0.7000	0.7700	16.3863	(76)
South	5.6200	46.7521	0.6300	0.7000	0.7700	80.2988	(78)
West	2.7300	19.6403	0.6300	0.7000	0.7700	16.3863	(80)

Solar gains	151.7754	269.5842	398.7843	545.1979	657.9621	674.1858	641.2423	553.7895	448.9018	305.9627	183.7914	128.6017	(83)
Total gains	736.7311	867.6798	972.3920	1098.5085	1183.4127	1177.7039	1125.6488	1039.1833	948.8923	826.1157	735.5508	701.4171	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.9788	52.1547	52.3283	53.1592	53.3176	54.0675	54.0675	54.2087	53.7762	53.3176	52.9981	52.6682	
alpha	4.4653	4.4770	4.4886	4.5439	4.5545	4.6045	4.6045	4.6139	4.5851	4.5545	4.5332	4.5112	
util living area	0.9834	0.9659	0.9301	0.8358	0.6804	0.4941	0.3611	0.4063	0.6376	0.8824	0.9673	0.9863	(86)
MIT	19.7248	19.9773	20.2995	20.6749	20.8971	20.9813	20.9964	20.9940	20.9426	20.6378	20.1270	19.6905	(87)
Th 2	20.0468	20.0497	20.0526	20.0660	20.0685	20.0802	20.0802	20.0824	20.0757	20.0685	20.0634	20.0581	(88)
util rest of house	0.9794	0.9581	0.9144	0.8029	0.6274	0.4273	0.2867	0.3272	0.5660	0.8501	0.9584	0.9830	(89)
MIT 2	18.5744	18.8934	19.2932	19.7452	19.9828	20.0688	20.0789	20.0799	20.0362	19.7169	19.0952	18.5392	(90)
Living area fraction									fLA = Living area / (4) =			0.3563	(91)
MIT	18.9843	19.2796	19.6517	20.0764	20.3086	20.3939	20.4058	20.4056	20.3591	20.0450	19.4628	18.9494	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9843	19.2796	19.6517	20.0764	20.3086	20.3939	20.4058	20.4056	20.3591	20.0450	19.4628	18.9494	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9736	0.9502	0.9066	0.8033	0.6416	0.4504	0.3132	0.3553	0.5888	0.8492	0.9513	0.9778	(94)
Useful gains	717.2466	824.4460	881.5874	882.4270	759.2382	530.4431	352.5440	369.2465	558.7394	701.5204	699.6990	685.8730	(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	1419.6478	1385.5013	1262.9953	1056.5254	811.3630	538.5044	353.7205	371.3211	584.8972	890.1949	1172.2284	1407.2822	(97)
Space heating kWh	522.5866	377.0291	283.7675	125.3508	38.7809	0.0000	0.0000	0.0000	0.0000	140.3738	340.2211	536.7284	(98a)
Space heating requirement - total per year (kWh/year)												2364.8381	
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	522.5866	377.0291	283.7675	125.3508	38.7809	0.0000	0.0000	0.0000	0.0000	140.3738	340.2211	536.7284	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2364.8381	
Space heating per m2											(98c) / (4) =	25.5382	(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	522.5866	377.0291	283.7675	125.3508	38.7809	0.0000	0.0000	0.0000	0.0000	140.3738	340.2211	536.7284	(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)	566.1826	408.4822	307.4404	135.8080	42.0161	0.0000	0.0000	0.0000	0.0000	152.0843	368.6036	581.5042	(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	240.1376	212.3086	225.6740	199.0242	193.2676	174.5446	172.6849	179.4111	181.2052	201.5554	213.6486	237.6234	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7550	85.3330	84.5746	83.0528	81.1750	79.8000	79.8000	79.8000	79.8000	83.2645	85.0979	85.8295	(217)
Fuel for water heating, kWh/month	280.0277	248.8003	266.8342	239.6356	238.0877	218.7276	216.3971	224.8259	227.0742	242.0665	251.0621	276.8551	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	25.5485	20.4960	18.4543	13.5204	10.4436	8.5325	9.5270	12.3835	16.0850	21.1044	23.8373	26.2586	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.4830	-36.0982	-54.2331	-63.8149	-71.2784	-67.4114	-66.5659	-61.6068	-53.3066	-42.5000	-27.4649	-20.9849	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-9.4132	-20.1805	-40.8299	-62.3996	-83.5799	-84.3909	-83.4203	-70.1580	-50.7893	-29.2344	-12.6854	-7.4173	(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	2562.1215	(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	2930.3940	(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)	206.1911	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1144.2468	(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	4640.4599	(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	2562.1215	0.2100	538.0455	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2930.3940	0.2100	615.3827	(264)
Space and water heating			1153.4283	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	206.1911	0.1443	29.7598	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-589.7481	0.1337	-78.8277	
PV Unit electricity exported	-554.4986	0.1254	-69.5245	
Total			-148.3521	(269)
Total CO2, kg/year			1046.7651	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.3000	(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	2562.1215	1.1300	2895.1973	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2930.3940	1.1300	3311.3452	(278)
Space and water heating			6206.5425	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	206.1911	1.5338	316.2628	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-589.7481	1.4939	-881.0510	
PV Unit electricity exported	-554.4986	0.4602	-255.1887	
Total			-1136.2397	(283)
Total Primary energy kWh/year			5516.6665	(286)
Target Primary Energy Rate (TPER)			59.5800	(287)

Appendix 4

M&E Specification Information

mesbuildingsolutions.co.uk
Newark Beacon, Cafferata Way, Newark, Nottinghamshire NG24 2TN

MECHANICAL & ELECTRICAL REPORT

FROGNAL WAY

LONDON

CJR Maintenance Solutions Ltd
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Date: January 2025
Document Nr: EB250102/FW/M&ER/001

Revision Record Table

Revision	Description	Date	Author
001	Formal Issue		CJR
002	Add Mitsubishi Unit	16th Jan 2055	CJR

Table of Contents Page

1. Introduction

1.1. Scope of the Report

This report has been commissioned by MES Building Solutions to provide mechanical and electrical consultation on the proposed Frognal Way development of seven apartments within a new construction.

The report will advise on: -

- proposed heating solution.
- size and location of external and internal plant
- noise output of external plant
- potential electrical load for the entire property
- riser sizes
- hot water generation

1.2. Documents Reviewed

- GA Elevation - North_DRAFT
- GA Elevation - South_DRAFT
- GA Plan - Level 01_DRAFT
- GA Plan - Level 02_DRAFT
- GA Plan - Level LG_DRAFT
- GA Plan - Level UG_DRAFT
- GA Section AA_DRAFT
- GA Section BB_DRAFT

1.3. Limitations of the Report

The report is based on the information above and scope agreed with MES Building Solutions to provide the information set out within section 1.1.

The heating system and electrical calculations are performed based on the m2 areas of the apartments utilising the BISRA Rules of Thumb 5th Edition BG 9/2011. A detailed calculation from the tendering contractor needs to be performed for both heating and electrical services as the calculations have assumed RoT and a standard apartment fit out.

The appendices showing the proposed ASHP data information is to be used for space and noise assessment, but the tendering contractor will need to verify the loading and size of the plant ands may choose to utilise and alternative supplier.

The hot water and control selection are for space planning purposes and a slim line unit may be utilised however at this stage we have selected a standard unit.

It is noted there are no roof plans and limited external drawings provided.

2. Executive Summary

2.1. Proposed Heating Solution

Due to the size of the development, it is understood the building will not be subject the London Planning stipulations of being connected to a communal heating scheme additionally it is not known the nearest location and so the heating and hot water generation solution will be from an Air Source Heat Pump (ASHP).

For this report it is proposed to use the Mitsubishi Ecodan Monobloc series units. These are high efficiency Air to Water heat pumps utilising R32 refrigerant.

The data sheets for each unit and the installation manual can be found within the appendices however the detailed information is taken from the data sheet and included in the report below.

Typically, a rule of thumb for ASHP sizing is 1kw for every 10m^2.

The following table applies for the apartment's selection of ASHP based on area.

Apartment no.	m2 Area	Heating Required (kW)	Unit Selected
1	86	8.6	PUZ-WM112VAA
2	78	7.8	PUZ-WM85VAA
3	61	6.1	PUZ-WM85VAA
4	40	4	PUZ-WM60VAA
5	61	6.1	PUZ-WM85VAA
6	50	5	PUZ-WM60VAA
7	63	6.3	PUZ-WM85VAA

This means that the larger apartment no. 1 will have a 12 kw system while the mid-size apartments will have the 8.5 kW system and the 2 smaller apartments will have 6 kW units.

It is proposed to utilise the Mitsubishi Proprietary Control Panel and link it to any underfloor heating company controller and then onto a Sangamo Choice PR2n Heating and hot water control panel.

It is not clear on the heat emitter strategy and there are various options from underfloor, radiators, skirting heating or radiant panels, the choice is often on space utilisation and an underfloor solution best fits this strategy.

2.2. Size and location of external and internal plant

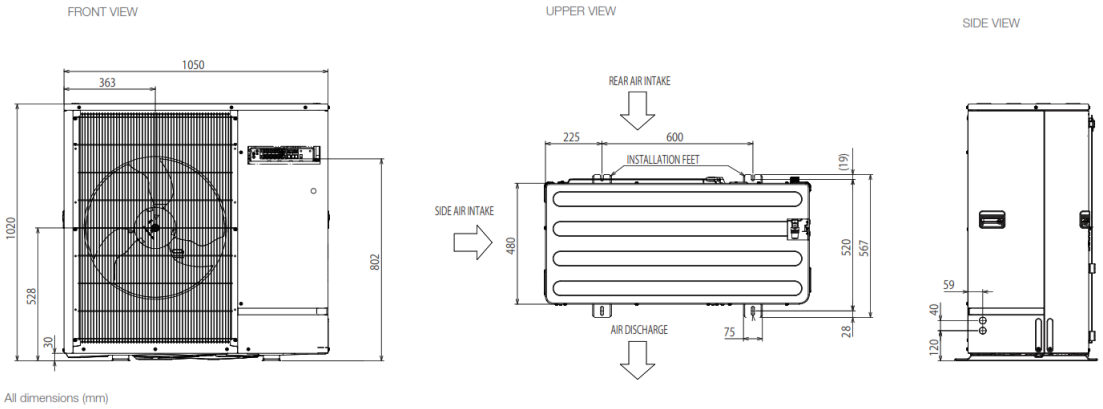
It is noted that the plans do not show any external plant locations, and these will need to be included to accommodate the external ASHP plant.

There is no indication of any cylinder cupboard within the apartments.

It is also noted that there are no obvious risers on the plans to take the ASHP heating pipes and wiring to the respective apartment whether this be on the ground floor, mounted on walls or on the roof.

NB! please make sure, when planning this space, the maintenance area is retained otherwise the installer will not be able to warranty the unit and system.

It is noted that all units are the same physical size see below



Please also see all other requirements in the data sheet within the appendices.

The internal plant for the ASHP is relatively small if a hot water cylinder is selected and can generally be mounted on a wall or within a cupboard or cylinder cupboard see section 2.6.

2.3. Noise output of external plant

The Sound Power level at 1 metre for the units serving apartments 4 and 6 will be 58 dB (A)
The Sound Pressure level at 1 metre for the units serving apartments 4 and 6 will be 45 dB (A)

The Sound Power level at 1 metre for the units serving the apartments 2, 3, 5, & 7 will be 58 dB (A)
The Sound Power level at 1 metre for the units serving the remaining apartments will be 45 dB (A)

The Sound Power level at 1 metre for the units serving apartment 1 will be 60 dB (A)
The Sound Power level at 1 metre for the units serving apartment 1 will be 45 dB (A)

Location of the units next to windows, adjoining properties and on roofs for the apartment below need an acoustic consultant to review the impact. Additionally, correct mounting to prevent vibration also needs to be considered.

2.4. Potential electrical load for the entire property

Based on the BISRA rules of thumb an apartment that is electrically heated would require 7.5 kW per apartment and as a block a coincident diversity may be applied.

In reality the local District Network Operator will designate circa 4 to 5 kVA to each apartment and will be provided with a single phase 80 to 100amp fused supply.

NB! the units selected as above will need to be single phase motor driven units and have the fused supply as the data sheet attached in the appendices.

2.5. Riser sizes

The plans do not show any obvious risers from the grounds floor to the apartments above or below.

There will be a need to get not only the ASHP heating pipework and cabling from the ASHP external locations to each apartment but also to get the main incoming electric water and telecoms to each apartment space.

As a minimum a 250mm square riser needs to be considered and this will need to be accessible including any metering strategy and meter locations agreed to determine the best riser location, it may mean there are several risers to accommodate various supplies.

2.6. Hot water generation

It is proposed to install a Proprietary Mitsubishi Unvented Hot Water cylinder in each apartment fed from the external ASHP, as the apartment look to have a bath within the bathroom it is recommended that a minimum 100 litre unit is installed complete with immersion back up.

The plans do not show any hot water cylinder storage space and an area circa 1000mm deep by 800mm wide would be sufficient.

3. Conclusion

The apartments need to have some space planning provided as the above information to accommodate an ASHP solution, this includes providing external plant space, internal hot water cylinder cupboards and risers to accommodate not only the incoming supplies but also the ASHP heating pipe requirements.

Signed: *C J Rainsforth* Director

4. Disclosure

This report is based on the information provided by MES and the drawings issued, utilising the rules of thumb calculations, the selection of plant needs to be fully verified by the company liable for design responsibility.

5. Appendices

Heating | Product Information

MITSUBISHI ELECTRIC

PUZ-WM60VAA(-BS)

Ecodan R32
Monobloc Air Source Heat Pump

R32

Key Features:

- A+++ high efficiency system
- Ultra quiet noise levels
- Maintains full heating capacity at low temperatures
- Zero carbon solution
- MELCloud enabled

Key Benefits:

- Ultra low running cost
- Flexible product placement
- Confident and quick product selection
- Help to tackle the climate crisis
- Remote control, monitoring, maintenance and technical support

MELCloud

Manufactured in the UK

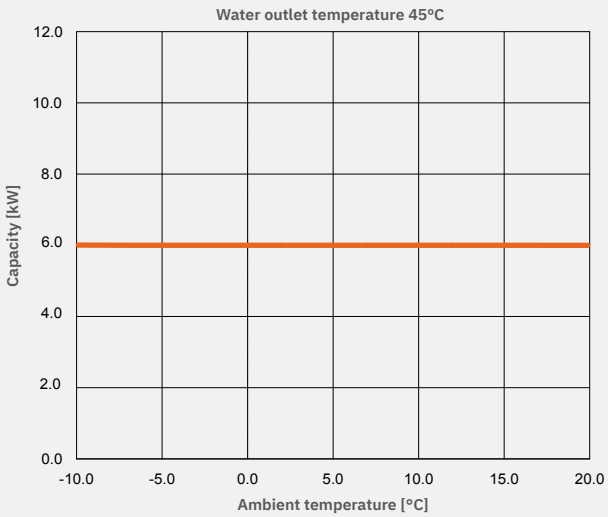
037-0033-20-01

Heating | **Product Information**

PUZ-WM60VAA(-BS)
Ecodan R32
Monobloc Air Source Heat Pump

OUTDOOR UNIT		PUZ-WM60VAA(-BS)
HEAT PUMP SPACE HEATER - 55˚C	ErP Rating	A++
	η_s	142%
	SCOP (MCS)	3.57
HEAT PUMP SPACE HEATER - 35˚C	ErP Rating	A+++
	η_s	190%
	SCOP (MCS)	4.81
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	145%
HEATING*2 (A-7/W35)	Capacity (kW)	6.0
	Power Input (kW)	1.88
	COP	3.20
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)	22
	Flow Rate (l/min)	17
	Water Pressure Drop (kPa)	8.0
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	5.68 [13]
	Fuse Rating - MCB Sizes (A)*6	16
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	2.2 / 1.49

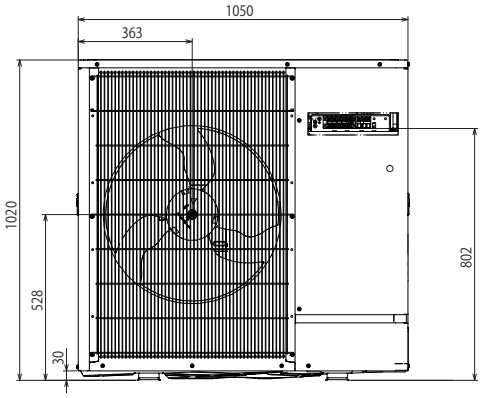
NOMINAL HEATING CAPACITY



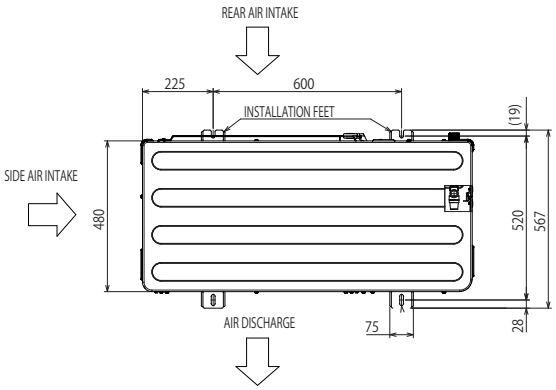
Notes:
*1 Combination with E*PT20X Cylinder
*2 Under normal heating conditions at outdoor temp: -7°CDB / -8°CWB, outlet water temp 35°C, inlet water temp 30°C.
*3 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 55°C, inlet water temp 47°C as tested to BS EN14511.
*4 Sound power level tested to BS EN12102.
*5 Under nominal heating conditions at outdoor temp: 7ºC, outlet water temp: 35ºC.
*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-WM60VAA(-BS) DIMENSIONS

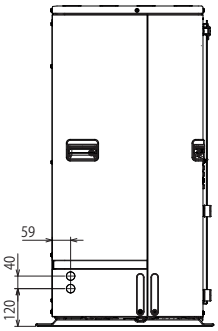
FRONT VIEW



UPPER VIEW



SIDE VIEW



All dimensions (mm)

MITSUBISHI ELECTRIC
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IRELAND Mitsubishi Electric Europe, Westgate Business Park, Ballymount, Dublin 24, Ireland. Telephone: (01) 419 8800 Fax: (01) 419 8890 International code: (003531)

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).

Effective as of August 2020

Green Gateway greengateway.mitsubishielectric.co.uk

Heating | Product Information

MITSUBISHI ELECTRIC

PUZ-WM85VAA(-BS)

Ecodan R32
Monobloc Air Source Heat Pump

R32

Key Features:

- A+++ high efficiency system
- Ultra quiet noise levels
- Maintains full heating capacity at low temperatures
- Zero carbon solution
- MELCloud enabled

Key Benefits:

- Ultra low running cost
- Flexible product placement
- Confident and quick product selection
- Help to tackle the climate crisis
- Remote control, monitoring, maintenance and technical support

MELCloud

Manufactured in the UK

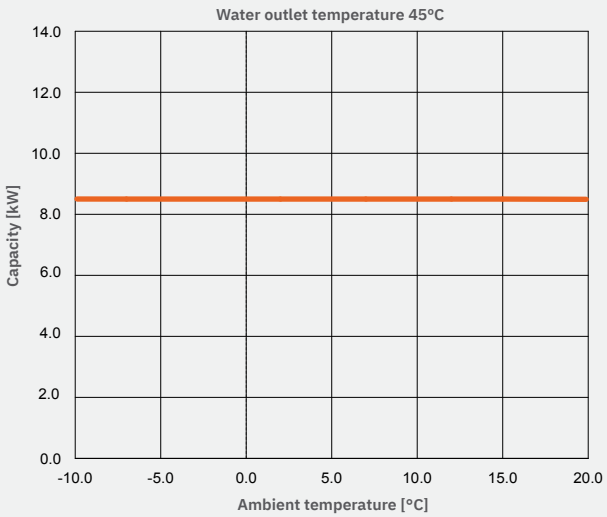
037-0033-20-03

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

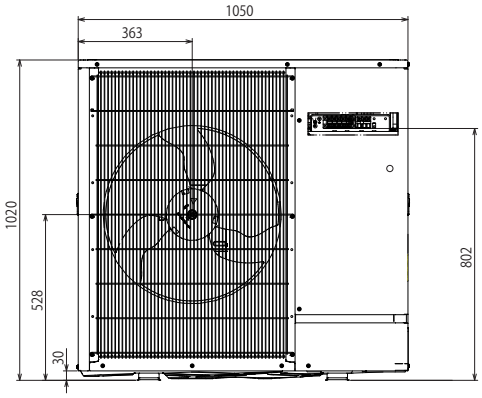
NOMINAL HEATING CAPACITY



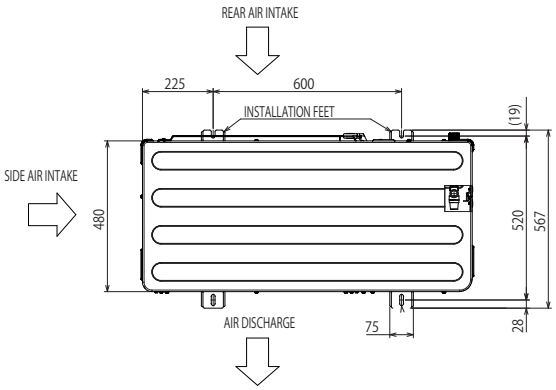
Notes:
*1 Combination with E*PT20X Cylinder
*2 Under normal heating conditions at outdoor temp: -7°CDB / -8°CWB, outlet water temp 35°C, inlet water temp 30°C.
*3 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 55°C, inlet water temp 47°C as tested to BS EN14511.
*4 Sound power level tested to BS EN12102.
*5 Under nominal heating conditions at outdoor temp: 7ºC, outlet water temp: 35ºC.
*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

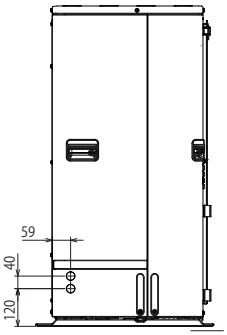
FRONT VIEW



UPPER VIEW



SIDE VIEW



All dimensions (mm)

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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).

Effective as of August 2020

Green Gateway greengateway.mitsubishielectric.co.uk

Heating | Product Information

MITSUBISHI ELECTRIC

PUZ-WM112VAA(-BS)

Ecodan R32
Monobloc Air Source Heat Pump

R32

Key Features:

- A+++ high efficiency system
- Ultra quiet noise levels
- Maintains full heating capacity at low temperatures
- Zero carbon solution
- MELCloud enabled

Key Benefits:

- Ultra low running cost
- Flexible product placement
- Confident and quick product selection
- Help to tackle the climate crisis
- Remote control, monitoring, maintenance and technical support

MELCloud

Manufactured in the UK

037-0034-20-01

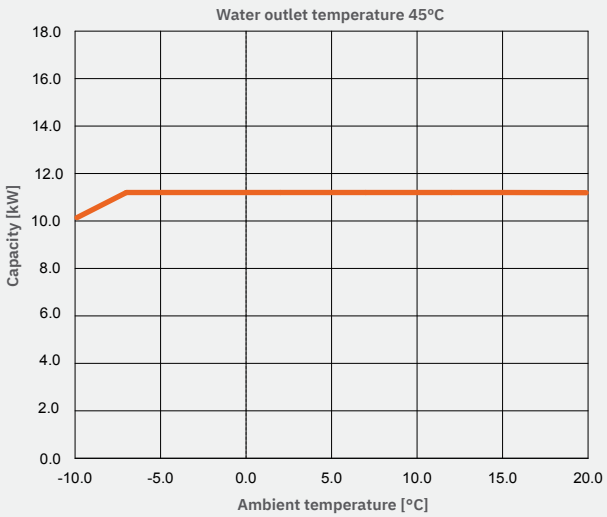
ecodan®
Renewable Heating Technology

Heating | **Product Information**

PUZ-WM112VAA(-BS)
Ecodan R32
Monobloc Air Source Heat Pump

OUTDOOR UNIT		PUZ-WM112VAA(-BS)
HEAT PUMP SPACE HEATER - 55˚C	ErP Rating	A++
	η_s	134%
	SCOP (MCS)	3.34
HEAT PUMP SPACE HEATER - 35˚C	ErP Rating	A+++
	η_s	191%
	SCOP (MCS)	4.74
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	148%
HEATING*2 (A-7/W35)	Capacity (kW)	11.2
	Power Input (kW)	3.73
	COP	3.00
OPERATING AMBIENT TEMPERATURE (°C DB)		-25 ~ +35
SOUND DATA*3	Pressure Level at 1m (dBA)	45
	Power Level (dBA)*4	60
WATER DATA	Pipework Size (mm)	28
	Flow Rate (l/min)	32
	Water Pressure Drop (kPa)	24.0
DIMENSIONS (mm)	Width	1050
	Depth	480
	Height	1020
WEIGHT (kg)		119
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz
	Phase	Single
	Nominal Running Current [MAX] (A)*5	10.9 [28]
	Fuse Rating - MCB Sizes (A)*6	32
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	3.0 / 2.03

NOMINAL HEATING CAPACITY



Notes:
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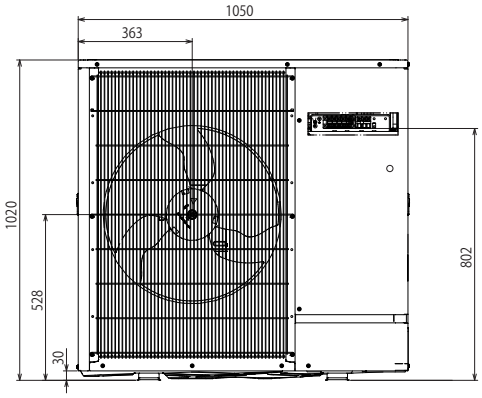
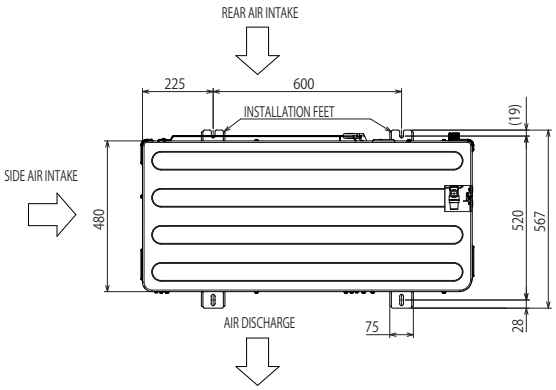
*4 Sound power level tested to BS EN12102.
*5 Under nominal heating conditions at outdoor temp: 7ºC, outlet water temp: 35ºC.
*6 MCB Sizes BS EN60898-2 & BS EN60947-2.
η_s is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

PUZ-WM112VAA(-BS) DIMENSIONS

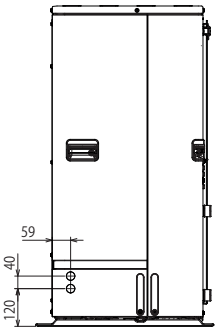
FRONT VIEW



UPPER VIEW



SIDE VIEW



All dimensions (mm)

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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).

Effective as of August 2020

Green Gateway greengateway.mitsubishielectric.co.uk

MITSUBISHI ELECTRIC

Air to Water Heat Pump
PUZ-WM • AA series, PUZ-WM • HA series

INSTALLATION MANUAL
FOR INSTALLER

For safe and correct use, read this manual and the indoor unit installation manual thoroughly before installing the outdoor unit. English is original. The other languages versions are translation of the original.

English

INSTALLATIONSHANDBUCH
FÜR INSTALLATEURE

Aus Sicherheitsgründen und zur richtigen Verwendung vor der Installation der Außenanlage das vorliegende Handbuch und die Installationsanleitung der Innenanlage gründlich durchlesen. Das Original ist in Englisch. Die anderen Sprachversionen sind vom Original übersetzt.

Deutsch

MANUEL D'INSTALLATION
POUR L'INSTALLATEUR

Avant d'installer l'appareil extérieur, lire attentivement ce manuel, ainsi que le manuel d'installation de l'appareil intérieur pour une utilisation sûre et correcte. L'anglais est l'original. Les versions fournies dans d'autres langues sont des traductions de l'original.

Français

INSTALLATIEHANDLEIDING
VOOR DE INSTALLATEUR

Lees voor een veilig en juist gebruik deze handleiding en de installatiehandleiding van het binnenapparaat zorgvuldig door voordat u met het installeren van het buitenapparaat begint. Het Engels is het origineel. De andere taalversies zijn vertalingen van het origineel.

Nederlands

MANUAL DE INSTALACIÓN
PARA EL INSTALADOR

Para un uso correcto y seguro, lea detalladamente este manual y el manual de instalación de la unidad interior antes de instalar la unidad exterior. El idioma original del documento es el inglés. Las versiones en los demás idiomas son traducciones del original.

Español

MANUALE DI INSTALLAZIONE
PER L'INSTALLATORE

Per un uso sicuro e corretto, leggere attentamente il presente manuale ed il manuale d'installazione dell'unità interna prima di installare l'unità esterna. Il testo originale è redatto in lingua Inglese. Le altre versioni linguistiche rappresentano traduzioni dell'originale.

Italiano

ΕΓΧΕΙΡΙΔΙΟ ΟΔΗΓΙΩΝ ΕΓΚΑΤΑΣΤΑΣΗΣ
ΓΙΑ ΑΥΤΟΝ ΠΟΥ ΚΑΝΕΙ ΤΗΝ ΕΓΚΑΤΑΣΤΑΣΗ

Για σωστή και ασφαλή χρήση, διαβάστε προσεκτικά αυτό το εγχειρίδιο καθώς και το εγχειρίδιο εγκατάστασης της εσωτερικής μονάδας, προτού εγκαταστήσετε την εξωτερική μονάδα. Η γλώσσα του πρωτοτύπου είναι η αγγλική. Οι εκδόσεις άλλων γλωσσών είναι μεταφράσεις του πρωτοτύπου.

Ελληνικά

MANUAL DE INSTALAÇÃO
PARA O INSTALADOR

Para uma utilização segura e correcta, leia atentamente este manual e o manual de instalação da unidade interior antes de instalar a unidade exterior. O idioma original é o inglês. As versões em outros idiomas são traduções do idioma original.

Português

INSTALLATIONSMANUAL
TIL INSTALLATØREN

Læs af sikkerhedshensyn denne manual samt manualen til installation af indendørsenheden grundigt, før du installerer udendørsenheden. Engelsk er originalsproget. De andre sprogversioner er oversættelser af originalen.

Dansk

INSTALLATIONSMANUAL
FÖR INSTALLATÖREN

Läs bruksanvisningen och inomhusenhetens installationshandbok noga innan du installerar utomhusenhet för säker och korrekt användning. Engelska är originalspråket. De övriga språkversionerna är översättningar av originalet.

Svenska

INSTALLASJONSHÅNDBOK
FOR MONTØR

For å sikre trygg og riktig bruk skal denne håndboken samt installasjonshåndboken for innendørsenheten leses grundig igjennom før enheten installeres. Engelsk er originalspråket. De andre språkversjonene er oversettelser av originalen.

Norsk

ASENNUSOPAS
ASENTAJALLE

Turvallisen ja asianmukaisen käytön varmistamiseksi lue tämä opas sekä sisäyksikön asennusopas huolellisesti ennen ulkoyksikön asentamista. Alkuperäiskieli on englanti. Muut kieliversiot ovat alkuperäisen käännöksiä.

Suomi

NÁVOD K MONTÁŽI
PRO MONTÉRA

Kvůli zajištění bezpečného a správného používání si před montáží vnější jednotky pečlivě přečtěte tento návod i návod k montáži vnitřní jednotky. Verze v angličtině je originál. Ostatní jazykové verze jsou překladem originálu.

Čeština

INSTRUKCJA MONTAŻU
DLA INSTALATORA

Aby zapewnić bezpieczne i prawidłowe korzystanie z urządzenia, przed montażem jednostki zewnętrznej należy dokładnie zapoznać się z treścią niniejszej instrukcji oraz instrukcji montażu jednostki wewnętrznej. Oryginalną instrukcję sporządzono w języku angielskim. Pozostałe wersje językowe zostały przetłumaczone z oryginału.

Polski

РЪКОВОДСТВО ЗА МОНТАЖ
ЗА ИНСТАЛАТОРА

За безопасно и правилно използване, прочетете внимателно това ръководство и ръководството за монтаж на вътрешното тяло, преди да монтирате външното тяло. Версията на английски език е оригинал. Версиите на други езици са превод от оригинала.

Български

NÁVOD NA INŠTALÁCIU
PRE MONTÉRA

V záujme bezpečného a správneho používania si pred inštaláciou exteriérovej jednotky prečítajte tento návod a návod na inštaláciu interiérovej jednotky. Preklad anglického originálu. Všetky jazykové verzie sú preložené z angličtiny.

Slovenčina

TELEPÍTÉSI KÉZIKÖNYV
A TELEPÍTŐ RÉSZÉRE

A biztonságos és helyes használat érdekében a kültéri egység felszerelése előtt olvassa el figyelmesen ezt a használati utasítást és a beltéri egység telepítési kézikönyvét. Az angol változat az eredeti. A többi nyelvi változat az eredeti fordítása.

Magyar

PRIROČNIK ZA NAMESTITEV
ZA MONTERJA

Za varno in pravilno uporabo natančno preberite ta navodila za uporabo in namestitveni priročnik za notranjo enoto, preden namestite zunanjo enoto. Izvirnik je v angleščini. Druge jezikovne različice so prevodi izvirnika.

Slovenščina

MANUAL CU INSTRUCŢIUNI DE INSTALARE
PENTRU INSTALATOR

Pentru a utiliza aparatul corect şi în siguranţă, citiţi în întregime aceste instrucţiuni şi manualul de instalare al unităţii interioare înainte de a instala unitatea exterioară. Textul original este în limba engleză. Versiunile pentru celelalte limbi sunt traduceri ale originalului.

Română

PAIGALDUSJUHEND
PAIGALDAJALE

Ohutu ja õige kasutuse tagamiseks lugege see juhend ja siseruumides kasutatava seadme paigaldusjuhend enne välisseadme paigaldamist põhjalikult läbi. Originaaljuhend on ingliskeelne. Muudes keeltes versioonid on originaali tõlked.

Eesti

MONTĀŽAS ROKASGRĀMATA
UZSTĀDĪŠANAS SPECIĀLISTAM

Lai nodrošinātu pareizu un drošu iekārtas lietošanu, pirms ārējās iekārtas uzstādīšanas rūpīgi izlasiet šo rokasgrāmatu un iekšējās iekārtas montāžas rokasgrāmatu. Oriģināls ir angļu valodā. Versijas citās valodās ir oriģināla tulkojums.

Latviski

MONTAVIMO VADOVAS
SKIRTA MONTUOTOJUI

Prieš montuodami išorinį įrenginį, saugiam ir tinkamam naudojimui užtikrinti atidžiai perskaitykite šį vadovą ir vidinio įrenginio montavimo vadovą. Originalas yra anglų k. Versijos kitomis kalbomis yra originalo vertimas.

Lietuviškai

PRIRUČNIK ZA UGRADNJU
ZA INSTALATERA

Radi sigurne i pravilne uporabe pročitajte pažljivo ovaj priručnik i priručnik za postavljanje unutarnje jedinice prije postavljanja vanjske jedinice. Tekst je izvorno napisan na engleskom jeziku. Tekst na ostalim jezicima predstavlja prijevod izvorno napisanog teksta.

Hrvatski

UPUTSTVO ZA UGRADNJU
ZA MONTERA

Radi bezbedne i ispravne upotrebe, detaljno pročitajte ovo uputstvo i uputstvo za ugradnju unutrašnje jedinice pre nego što ugradite spoljnu jedinicu. Prevod originala. Verzije na drugim jezicima su prevodi originala.

Srpski

Contents

en

Note: This symbol mark is for EU countries only.
This symbol mark is according to the directive 2012/19/EU Article 14 Information for users and Annex IX.
Your MITSUBISHI ELECTRIC product is designed and manufactured with high quality materials and components which can be recycled and reused.
This symbol means that electrical and electronic equipment, at their end-of-life, should be disposed of separately from your household waste.
Please, dispose of this equipment at your local community waste collection/recycling centre.
In the European Union there are separate collection systems for used electrical and electronic product.
Please, help us to conserve the environment we live in!

⚠ CAUTION:

- **Do not vent R32 into the Atmosphere:**

1. Safety precautions

►Before installing the unit, make sure you read all the "Safety precautions".
►Please report to or take consent by the supply authority before connection to the system.
►Equipment complying with IEC/EN 61000-3-12 (PUZ-WM60/85/112VAA)

⚠ WARNING:

Describes precautions that must be observed to prevent danger of injury or death to the user.

⚠ CAUTION:

Describes precautions that must be observed to prevent damage to the unit.

After installation work has been completed, explain the "Safety Precautions," use, and maintenance of the unit to the customer according to the information in the Operation Manual and perform the test run to ensure normal operation. Both the Installation Manual and Operation Manual must be given to the user for keeping. These manuals must be passed on to subsequent users.

⏚ : Indicates a part which must be grounded.

⚠ WARNING:

Carefully read the labels affixed to the main unit.

MEANINGS OF SYMBOLS DISPLAYED ON THE UNIT

	**WARNING** (Risk of fire)	This mark is for R32 refrigerant only. Refrigerant type is written on nameplate of outdoor unit. In case that refrigerant type is R32, this unit uses a flammable refrigerant. If refrigerant leaks and comes in contact with fire or heating part, it will create harmful gas and there is risk of fire.
	Read the OPERATION MANUAL carefully before operation.	
	Service personnel are required to carefully read the OPERATION MANUAL and INSTALLATION MANUAL before operation.	
	Further information is available in the OPERATION MANUAL, INSTALLATION MANUAL, and the like.	

⚠ WARNING:

- **The unit must not be installed by the user. Ask a dealer or an authorized technician to install the unit. If the unit is installed incorrectly, water leakage, electric shock, or fire may result.**
- **For installation work, follow the instructions in the Installation Manual and use tools and pipe components specifically made for use with R32 refrigerant.**

  The R32 refrigerant in the HFC system is pressurized 1.6 times the pressure of usual refrigerants. If pipe components not designed for R32 refrigerant are used and the unit is not installed correctly, the pipes may burst and cause damage or injuries. In addition, water leakage, electric shock, or fire may result.
- **When installing the unit, use appropriate protective equipment and tools for safety.**
  Failure to do so could cause injuries.

1. Safety precautions

- **The unit must be installed according to the instructions in order to minimize the risk of damage from earthquakes, typhoons, or strong winds. An incorrectly installed unit may fall down and cause damage or injuries.**
- **The unit must be securely installed on a structure that can sustain its weight. If the unit is mounted on an unstable structure, it may fall down and cause damage or injuries.**
- **If the outdoor unit is installed in a small room, measures must be taken to prevent the refrigerant concentration in the room from exceeding the safety limit in the event of refrigerant leakage. Consult a dealer regarding the appropriate measures to prevent the allowable concentration from being exceeded. Should the refrigerant leak and cause the concentration limit to be exceeded, hazards due to lack of oxygen in the room may result.**
- **Ventilate the room if refrigerant leaks during operation. If refrigerant comes into contact with a flame, poisonous gases will be released.**
- **All electric work must be performed by a qualified technician according to local regulations and the instructions given in this manual. The units must be powered by dedicated power lines and the correct voltage and circuit breakers must be used. Power lines with insufficient capacity or incorrect electrical work may result in electric shock or fire.**
- **This appliance is intended to be used by expert or trained users in shops, in light industry and on farms, or for commercial use by lay persons.**
- **Use only specified cables for wiring. The wiring connections must be made securely with no tension applied on the terminal connections. Also, never splice the cables for wiring (unless otherwise indicated in this document).**
  Failure to observe these instructions may result in overheating or a fire.
- **If the supply cord is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid hazard.**
- **The appliance shall be installed in accordance with national wiring regulations.**
- **The terminal block cover panel of the outdoor unit must be firmly attached. If the cover panel is mounted incorrectly and dust and moisture enter the unit, electric shock or fire may result.**
- **When installing or relocating, or servicing the outdoor unit, use only the specified refrigerant (R32) to charge the refrigerant lines. Do not mix it with any other refrigerant and do not allow air to remain in the lines.**
  If air is mixed with the refrigerant, then it can be the cause of abnormal high pressure in the refrigerant line, and may result in an explosion and other hazards.
  The use of any refrigerant other than that specified for the system will cause mechanical failure or system malfunction or unit breakdown. In the worst case, this could lead to a serious impediment to securing product safety.
- **Use only accessories authorized by Mitsubishi Electric and ask a dealer or an authorized technician to install them. If accessories are incorrectly installed, water leakage, electric shock, or fire may result.**
- **Do not alter the unit. Consult a dealer for repairs. If alterations or repairs are not performed correctly, water leakage, electric shock, or fire may result.**
- **The user should never attempt to repair the unit or transfer it to another location. If the unit is installed incorrectly, water leakage, electric shock, or fire may result. If the outdoor unit must be repaired or moved, ask a dealer or an authorized technician.**
- **After installation has been completed, check for refrigerant leaks. If refrigerant leaks into the room and comes into contact with the flame of a heater or portable cooking range, poisonous gases will be released.**
- **Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.**
- **The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater).**
- **Do not pierce or burn.**
- **Be aware that refrigerants may not contain an odour.**
- **Compliance with national gas regulations shall be observed.**
- **Keep any required ventilation openings clear of obstruction.**

◎ **Do not use low temperature solder alloy in case of brazing the refrigerant pipes.**

◎ **When performing brazing work, be sure to ventilate the room sufficiently.**
Make sure that there are no hazardous or flammable materials nearby.
When performing the work in a closed room, small room, or similar location, make sure that there are no refrigerant leaks before performing the work.
If refrigerant leaks and accumulates, it may ignite or poisonous gases may be released.

◎ **The appliance shall be stored in a well-ventilated area where the room size corresponds to the room area as specified for operation.**

◎ **Keep gas-burning appliances, electric heaters, and other fire sources (ignition sources) away from the location where installation, repair, and other outdoor unit work will be performed.**
If refrigerant comes into contact with a flame, poisonous gases will be released.

◎ **Do not smoke during work and transportation.**

1. Safety precautions

1.1. Before installation

⚠ CAUTION:

- **Do not use the unit in an unusual environment. If the outdoor unit is installed in areas exposed to steam, volatile oil (including machine oil), or sulfuric gas, areas exposed to high salt content such as the seaside, or areas where the unit will be covered by snow, the performance can be significantly reduced and the internal parts can be damaged.**
- **Do not install the unit where combustible gases may leak, be produced, flow, or accumulate. If combustible gas accumulates around the unit, fire or explosion may result.**
- **The outdoor unit produces condensation during the heating operation. Make sure to provide drainage around the outdoor unit if such condensation is likely to cause damage.**
- **Remove the compressor's fixing component in accordance with the NOTICE attached to the unit. Running the unit with the fixing component mounted will result in increased noise.**
- **When installing the unit in a hospital or communications office, be prepared for noise and electronic interference. Inverters, home appliances, high-frequency medical equipment, and radio communications equipment can cause the outdoor unit to malfunction or breakdown. The outdoor unit may also affect medical equipment, disturbing medical care, and communications equipment, harming the screen display quality.**
- **When the unit is running, vibrations or the noise of refrigerant running may be heard from the extension piping. Try to avoid installing the piping to thin walls, etc. as much as possible and provide sound insulation with the piping cover, etc.**

1.2. Before installation (relocation)

⚠ CAUTION:

- **Be extremely careful when transporting or installing the units. Two or more persons are needed to handle the unit, as it weighs 20 kg or more. Do not grasp the packaging bands. Wear protective gloves to remove the unit from the packaging and to move it, as you can injure your hands on the fins or the edge of other parts.**
- **Be sure to safely dispose of the packaging materials. Packaging materials, such as nails and other metal or wooden parts may cause stabs or other injuries.**
- **The base and attachments of the outdoor unit must be periodically checked for looseness, cracks or other damage. If such defects are left uncorrected, the unit may fall down and cause damage or injuries.**
- **Do not clean the outdoor unit with water. Electric shock may result.**

1.3. Before electric work

⚠ CAUTION:

- **Be sure to install circuit breakers. If not installed, electric shock may result.**
- **For the power lines, use standard cables of sufficient capacity. Otherwise, a short circuit, overheating, or fire may result.**
- **When installing the power lines, do not apply tension to the cables. If the connections are loosened, the cables can snap or break and overheating or fire may result.**
- **Be sure to ground the unit. Do not connect the ground wire to gas or water pipes, lightning rods, or telephone grounding lines. If the unit is not properly grounded, electric shock may result.**
- **Use circuit breakers (ground fault interrupter, isolating switch (+B fuse), and molded case circuit breaker) with the specified capacity. If the circuit breaker capacity is larger than the specified capacity, breakdown or fire may result.**

1.4. Before starting the test run

⚠ CAUTION:

- **Turn on the main power switch more than 12 hours before starting operation. Starting operation just after turning on the power switch can severely damage the internal parts. Keep the main power switch turned on during the operation season.**
- **Before starting operation, check that all panels, guards and other protective parts are correctly installed. Rotating, hot, or high voltage parts can cause injuries.**
- **Do not touch any switch with wet hands. Electric shock may result.**
- **Do not touch the refrigerant pipes with bare hands during operation. The refrigerant pipes are hot or cold depending on the condition of the flowing refrigerant. If you touch the pipes, burns or frostbite may result.**
- **After stopping operation, be sure to wait at least five minutes before turning off the main power switch. Otherwise, water leakage or breakdown may result.**

1.5. Using R32 refrigerant outdoor units

⚠ CAUTION:

- **Do not use refrigerant other than R32 refrigerant. If another refrigerant is used, the chlorine will cause the oil to deteriorate.**
- **Use the following tools specifically designed for use with R32 refrigerant. The following tools are necessary to use R32 refrigerant. Contact your nearest dealer for any questions.**

Tools (for R32)	
Gauge manifold	Flare tool
Charge hose	Size adjustment gauge
Gas leak detector	Vacuum pump adapter
Torque wrench	Electronic refrigerant charging scale

- **Be sure to use the correct tools. If dust, debris, or moisture enters the refrigerant lines, refrigeration oil deterioration may result.**

2. Installation location

en

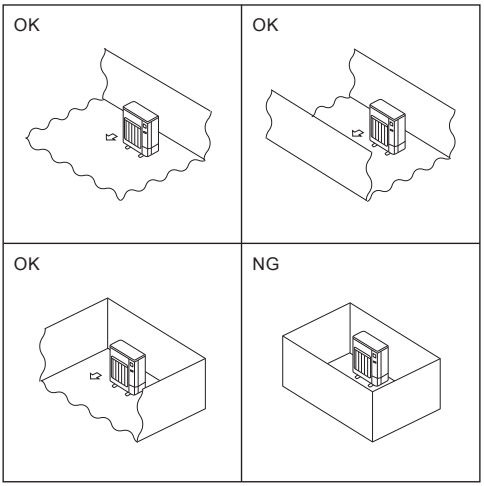
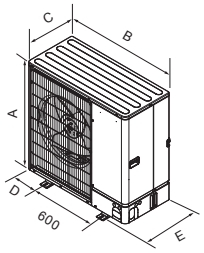


Fig. 2-1



(mm)

Models	A	B	C	D	E
50	943	950	330+30	175	370
60	1020	1050	480	225	520
85	1020	1050	480	225	520
112	1020	1050	480	225	520

Fig. 2-2

2.1. Choosing the outdoor unit installation location

◎ R32 is heavier than air—as well as other refrigerants—so tends to accumulate at the base (in the vicinity of the floor). If R32 accumulates around base, it may reach a flammable concentration in case room is small. To avoid ignition, maintaining a safe work environment is required by ensuring appropriate ventilation. If a refrigerant leak is confirmed in a room or an area where there is insufficient ventilation, refrain from using of flames until the work environment can be improved by ensuring appropriate ventilation.

- Avoid locations exposed to direct sunlight or other sources of heat.
- Select a location from which noise emitted by the unit will not inconvenience neighbors.
- Select a location permitting easy wiring and pipe access to the power source and indoor unit.
- Avoid locations where combustible gases may leak, be produced, flow, or accumulate.
- Note that water may drain from the unit during operation.
- Select a level location that can bear the weight and vibration of the unit.
- Avoid locations where the unit can be covered by snow. In areas where heavy snow fall is anticipated, special precautions such as raising the installation location or installing a hood on the air intake must be taken to prevent the snow from blocking the air intake or blowing directly against it. This can reduce the airflow and a malfunction may result.
- Avoid locations exposed to oil, steam, or sulfuric gas.
- Use the transportation handles of the outdoor unit to transport the unit. If the unit is carried from the bottom, hands or fingers may be pinched.

◎ Install outdoor units in a place where at least one of the four sides is open, and in a sufficiently large space without depressions. (Fig. 2-1)

⚠ CAUTION:

- **Perform grounding.**
  Do not connect the ground wire to a gas pipe, water pipe arrester or telephone ground wire. Defective grounding could cause an electric shock.
- **Do not install the unit in a place where an inflammable gas leaks.**
  If gas leaks and accumulates in the area surrounding the unit, it could cause an explosion.
- **Install a ground leakage breaker depending on the installation place (where it is humid).**
  If a ground leakage breaker is not installed, it could cause an electric shock.
- **Perform the drainage/piping work securely according to the installation manual.**
  If there is a defect in the drainage/piping work, water could drop from the unit and household goods could be wet and damaged.
- **Fasten a flare nut with a torque wrench as specified in this manual.**
  When fastened too tight, a flare nut may be broken after a long period and cause a leakage of refrigerant.

2.2. Outline dimensions (Outdoor unit) (Fig. 2-2)

2. Installation location

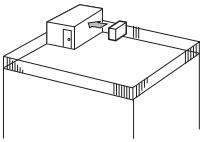


Fig. 2-3

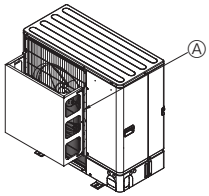


Fig. 2-4

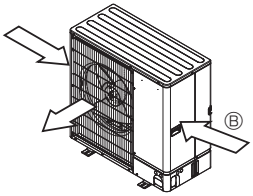


Fig. 2-5

2.3. Ventilation and service space

2.3.1. Windy location installation

When installing the outdoor unit on a rooftop or other location unprotected from the wind, situate the air outlet of the unit so that it is not directly exposed to strong winds. Strong wind entering the air outlet may impede the normal airflow and a malfunction may result.

The following shows three examples of precautions against strong winds.

① Face the air outlet towards the nearest available wall about 35 cm away from the wall. (Fig. 2-3)

② Install an optional air guide if the unit is installed in a location where strong winds from a typhoon, etc. may directly enter the air outlet. (Fig. 2-4)

Ⓐ Air outlet guide

③ Position the unit so that the air outlet blows perpendicularly to the seasonal wind direction, if possible. (Fig. 2-5)

Ⓑ Wind direction

2.3.2. When installing a single outdoor unit (Refer to the last page)

Minimum dimensions are as follows, except for Max., meaning Maximum dimensions, indicated.

Refer to the figures for each case.

① Obstacles at rear only (Fig. 2-6)

② Obstacles at rear and above only (Fig. 2-7)

- Do not install the optional air outlet guides for upward airflow.

③ Obstacles at rear and sides only (Fig. 2-8)

④ Obstacles at front only (Fig. 2-9)

⑤ Obstacles at front and rear only (Fig. 2-10)

⑥ Obstacles at rear, sides, and above only (Fig. 2-11)

- Do not install the optional air outlet guides for upward airflow.

2.3.3. When installing multiple outdoor units (Refer to the last page)

Leave 50 mm space or more between the units.

Refer to the figures for each case.

① Obstacles at rear only (Fig. 2-12)

② Obstacles at rear and above only (Fig. 2-13)

- No more than 3 units must be installed side by side. In addition, leave space as shown.
- Do not install the optional air outlet guides for upward airflow.

③ Obstacles at front only (Fig. 2-14)

④ Obstacles at front and rear only (Fig. 2-15)

⑤ Single parallel unit arrangement (Fig. 2-16)

* When using an optional air outlet guide installed for upward airflow, the clearance is 500 mm or more.

⑥ Multiple parallel unit arrangement (Fig. 2-17)

* When using an optional air outlet guide installed for upward airflow, the clearance is 1000 mm or more.

⑦ Stacked unit arrangement (Fig. 2-18)

- The units can be stacked up to two units high.
- No more than 2 stacked units must be installed side by side. In addition, leave space as shown.

2. Installation location

◎2.4. Minimum installation area

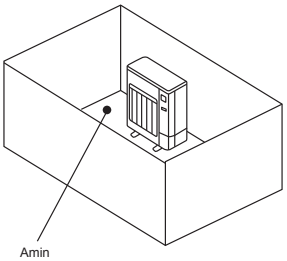
If you unavoidably install a unit in a space where all four sides are blocked or there are depressions, confirm that one of these situations (A, B or C) is satisfied.

Note: These countermeasures are for keeping safety not for specification guarantee.

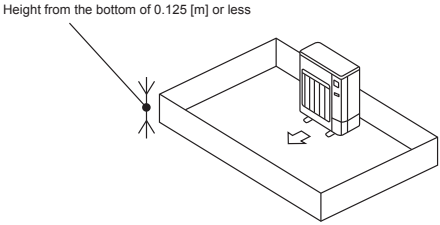
A) Secure sufficient installation space (minimum installation area Amin).
Install in a space with an installation area of Amin or more, corresponding to refrigerant quantity M (factory-charged refrigerant + locally added refrigerant).

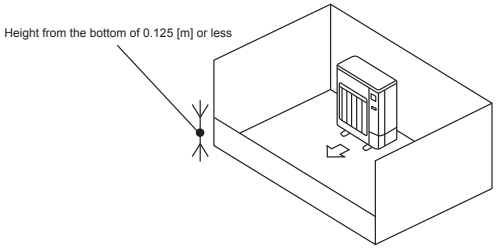
en

M [kg]	Amin [m²]
1.0	12
1.5	17
2.0	23
2.5	28
3.0	34
3.5	39
4.0	45
4.5	50
5.0	56
5.5	62
6.0	67
6.5	73
7.0	78
7.5	84

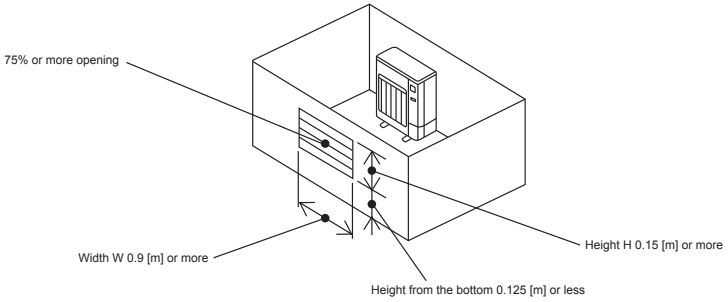


B) Install in a space with a depression height of ≦ 0.125 [m].



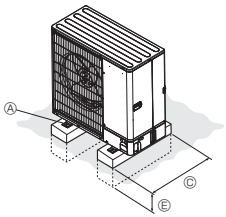


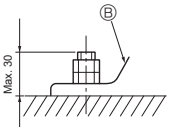
C) Create an appropriate ventilation open area.
Make sure that the width of the open area is 0.9 [m] or more and the height of the open area is 0.15 [m] or more.
However, the height from the bottom of the installation space to the bottom edge of the open area should be 0.125 [m] or less.
Open area should be 75% or more opening.



3. Installing the outdoor unit

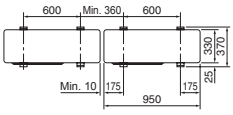
(mm)





Ⓐ M10 (3/8") bolt
Ⓑ Base
Ⓒ As long as possible.
Ⓓ Vent
Ⓔ Set deep in the ground

For WM50 models



For WM60/85/112 models

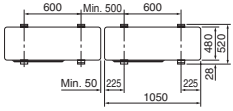


Fig. 3-1

- Be sure to install the unit in a sturdy, level surface to prevent rattling noises during operation. (Fig. 3-1)

<Foundation specifications>

Foundation bolt	M10 (3/8")
Thickness of concrete	120 mm
Length of bolt	70 mm
Weight-bearing capacity	320 kg

- Make sure that the length of the foundation bolt is within 30 mm of the bottom surface of the base.
- Secure the base of the unit firmly with four-M10 foundation bolts in sturdy locations.

Installing the outdoor unit

- Do not block the vent. If the vent is blocked, operation will be hindered and breakdown may result.
- In addition to the unit base, use the installation holes on the back of the unit to attach wires, etc., if necessary to install the unit. Use self-tapping screws (ø5 × 15 mm or less) and install on site.

en

⚠ WARNING:

- **The unit must be securely installed on a structure that can sustain its weight. If the unit is mounted on an unstable structure, it may fall down and cause damage or injuries.**
- **The unit must be installed according to the instructions in order to minimize the risk of damage from earthquakes, typhoons, or strong winds. An incorrectly installed unit may fall down and cause damage or injuries.**

⚠ CAUTION:

- **Install be unit on a rigid structure to prevent excessive operation sound or vibration.**

4. COMP fixed parts removing work (Only PUZ-WM112*AA)

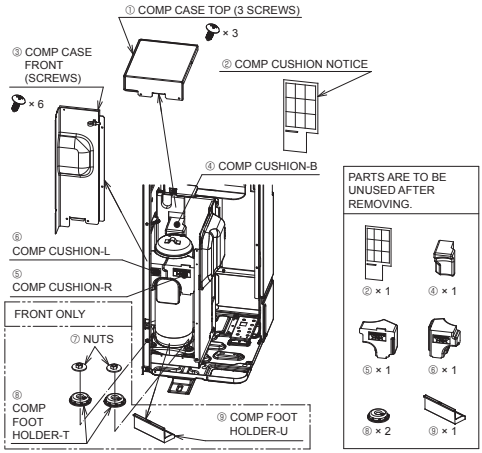
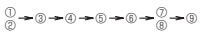


Fig. 4-1

- Before starting the unit operation, be sure to uncover the COMP CASE TOP and COMP CASE FRONT, and remove the COMP fixed parts. (Fig. 4-1)

REMOVING SEQUENCE



4. COMP fixed parts removing work (Only PUZ-WM112*AA)

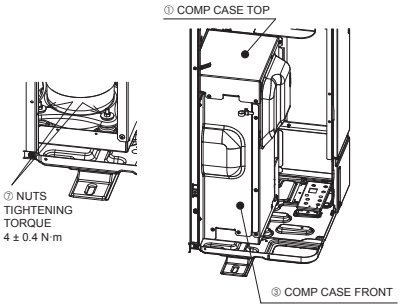


Fig. 4-2

- After removing the COMP fixed parts, be sure to tighten nuts, and make COMP CASE TOP and COMP CASE FRONT back to the original state. (Fig. 4-2)

REINSTALLING SEQUENCE
⑦ → ③ → ①
(SCREWS TIGHTENING TORQUE 1.5 ± 0.2 N·m)

Note:
- **This work is applicable to the following models.**
  PUZ-WM112VAA **PUZ-WM112YAA**
  PUZ-WM112VAA-BS **PUZ-WM112YAA-BS**

⚠ CAUTION:

- **If the COMP fixed parts are not removed, the operation noise may increase.**

⚠ WARNING:

- **Before the COMP fixed parts are removed, be sure to be breaker off. If not, the COMP case touches electrical parts and they may break down.**

5. Drainage piping work

Outdoor unit drainage pipe connection

When drain piping is necessary, use the drain socket or the drain pan (option).

	WM50	WM60	WM85	WM112
Drain socket	PAC-SG61DS-E			
Drain pan	PAC-SG64DP-E	PAC-SJ83DP-E		

6. Water piping work

6.1. Water piping connection (Fig. 6-1)

- Connect the water pipes to the outlet and inlet pipes.
  (Parallel male screw for 1-inch water pipe (ISO 228/1-G1B))
- Inlet and outlet pipes position is shown on the Fig. 6-1.
- Install the hydraulic filter at the water intake.
- Maximum allowable torque at the water piping connection is 50 N•m.
- Check if water leaks after installation.
- Inlet water gauge pressure must be between 0-0.3 MPa.
- Use the inlet water with a temperature lower than 55 ˚C.

Note:

- **The water velocity in pipes should be kept within certain limits of material to avoid erosion, corrosion and excessive noise generation. Be aware, and take care of, that local velocities in small pipes, bends and similar obstructions can exceed the values above.**
  e.g.) Copper : 1.5 m/s
- **When connecting metal pipes made of different materials, be sure to insulate the joint to prevent electrolytic etching.**
- **Set up a field system so that the inlet water temperature and water flow rate can be within the allowable range specified in our technical data, etc.**
  If the unit is used out of the allowable range, the parts of unit might be damaged.

6.2. Water quality condition

- The water in a system should be clean and with a pH value of 6.5-8.0.
- The followings are the maximum values;
  Calcium : 100 mg/L
  Chlorine : 100 mg/L
  Iron/manganese : 0.5 mg/L

[Fig. 6-1]
Ⓐ Water outlet
Ⓑ Water inlet

6.3. Minimum water quantity

Refer to the indoor unit installation manual.

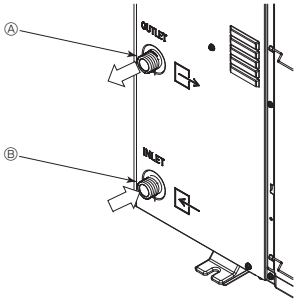


Fig. 6-1

Note: Make sure to perform the frozen prevention measure for water pipe system. (Water piping insulation, back-up pump system, using of a certain % ethylene glycol instead of normal water)
Insulate the water piping properly. The performance can be poor if the insulation is insufficient.

⚠ WARNING:

As the outlet water temperature can reach 60 ºC at maximum, do not touch the water piping directly with a bare hand.

Note:
Parts which require regular inspection

Parts	Check every	Possible failures
Pressure relief valve (3bar) Temperature and pressure relief valve	1 year (turning the knob manually)	PRV would be fixed and expansion vessel would burst

en

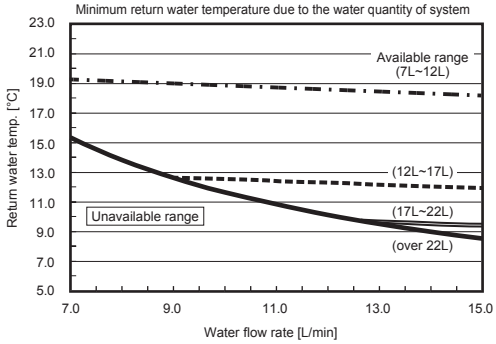
6. Water piping work

6.4. Available range (Water flow rate, return water temp.)

en

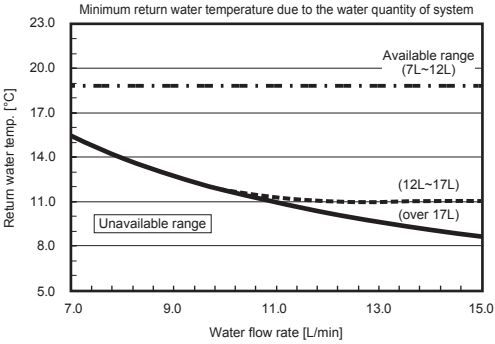
■ **Heating**

PUZ-WM50VHA(-BS)

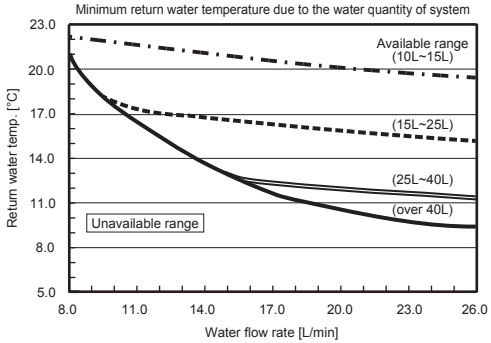


■ **Cooling**

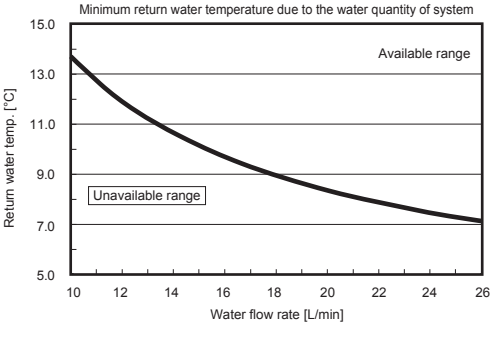
PUZ-WM50VHA(-BS)



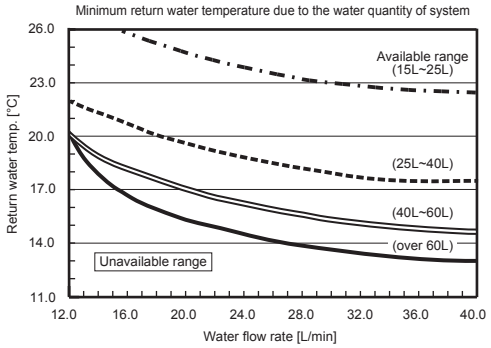
PUZ-WM60VAA(-BS) PUZ-WM85VAA(-BS) PUZ-WM85YAA(-BS)



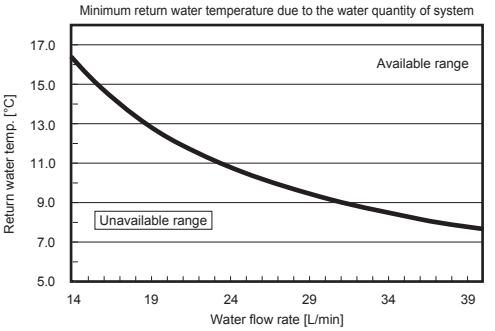
PUZ-WM60VAA(-BS) PUZ-WM85VAA(-BS) PUZ-WM85YAA(-BS)



PUZ-WM112VAA(-BS) PUZ-WM112YAA(-BS)



PUZ-WM112VAA(-BS) PUZ-WM112YAA(-BS)



Note:

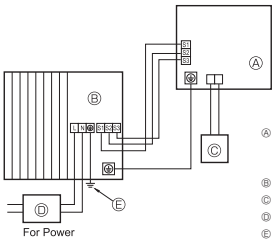
Be sure to avoid the unavailable range during defrosting.

Otherwise, the outdoor unit is insufficiently defrosted and/or the heat exchanger of the indoor unit may freeze.

7. Electrical work

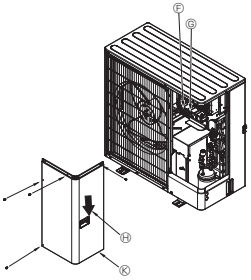
7.1. Outdoor unit (Fig. 7-1, Fig. 7-2)

① Remove the service panel.
② Wire the cables referring to the Fig. 7-1 and the Fig. 7-2.



Ⓐ Indoor unit
(Interface unit/
Flow temp. controller)
Ⓑ Outdoor unit
Ⓒ Remote controller
Ⓓ Main switch (Earth leakage breaker)
Ⓔ Earth

Fig. 7-1



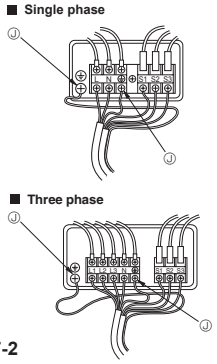


Fig. 7-2

Ⓕ Terminal block
Ⓖ Indoor/Outdoor connection terminal block (S1, S2, S3)
Ⓗ Service panel
Ⓙ Earth terminal
Ⓚ Wire the cables so that they do not contact the center of the service panel.

Note :
If the protective sheet for the electrical box is removed during servicing, be sure to reinstall it.

⚠ CAUTION:
Be sure to install N-Line. Without N-Line, it could cause damage to unit.

en

7. Electrical work

7.2. Field electrical wiring

Outdoor unit model			WM50V	WM60V	WM85V	WM112V	WM85, 112Y
Outdoor unit power supply			~/N (single), 50 Hz, 230 V	~/N (single), 50 Hz, 230 V	~/N (single), 50 Hz, 230 V	~/N (single), 50 Hz, 230 V	3N~ (3 ph 4-wires), 50 Hz, 400 V
Outdoor unit input capacity Main switch (Breaker)		*1	16 A	16 A	25 A	32 A	16 A
Wiring Wire No. × size (mm^2)	Outdoor unit power supply		3 × Min. 1.5	3 × Min. 2.5	3 × Min. 2.5	3 × Min. 4	5 × Min. 1.5
	Indoor unit-Outdoor unit	*2	3 × 1.5 (Polar)	3 × 1.5 (Polar)	3 × 1.5 (Polar)	3 × 1.5 (Polar)	3 × 1.5 (Polar)
	Indoor unit-Outdoor unit earth	*2	1 × Min. 1.5	1 × Min. 1.5	1 × Min. 1.5	1 × Min. 1.5	1 × Min. 1.5
	Remote controller-Indoor unit	*3	2 × 0.3 (Non-polar)	2 × 0.3 (Non-polar)	2 × 0.3 (Non-polar)	2 × 0.3 (Non-polar)	2 × 0.3 (Non-polar)
Circuit rating	Outdoor unit L-N (single) Outdoor unit L1-N, L2-N, L3-N (3 phase)	*4	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC
	Indoor unit-Outdoor unit S1-S2	*4	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC
	Indoor unit-Outdoor unit S2-S3	*4	24 VDC	24 VDC	24 VDC	24 VDC	24 VDC
	Remote controller-Indoor unit	*4	12 VDC	12 VDC	12 VDC	12 VDC	12 VDC

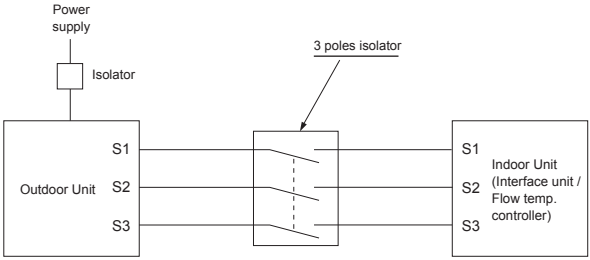
*1. A breaker with at least 3.0 mm contact separation in each poles shall be provided. Use earth leakage breaker (NV).
Make sure that the current leakage breaker is one compatible with higher harmonics.
Always use a current leakage breaker that is compatible with higher harmonics as this unit is equipped with an inverter.
The use of an inadequate breaker can cause the incorrect operation of inverter.

*2. Max. 45 m
If 2.5 mm^2 used, Max. 50 m
If 2.5 mm^2 used and S3 separated, Max. 80 m

*3. The 10 m wire is attached in the remote controller accessory.

*4. The figures are NOT always against the ground.
S3 terminal has 24 VDC against S2 terminal. However between S3 and S1, these terminals are NOT electrically insulated by the transformer or other device.

Notes:
1. **Wiring size must comply with the applicable local and national codes.**
2. **Power supply cables and the cables between Interface unit/Flow temp. controller and outdoor unit shall not be lighter than polychloroprene sheathed flexible cables. (Design 60245 IEC 57)**
3. **Be sure to connect the cables between Interface unit/Flow temp. controller and outdoor unit directly to the units (no intermediate connections are allowed).**
   Intermediate connections may result in communication errors. If water enters at the intermediate connection point, it may cause insufficient insulation to ground or a poor electrical contact.
   (If an intermediate connection is necessary, be sure to take measures to prevent water from entering the cables.)
4. **Install an earth longer than other cables.**
5. **Do not construct a system with a power supply that is turned ON and OFF frequently.**
6. **Use self-extinguishing distribution cables for power supply wiring.**
7. **Properly route wiring so as not to contact the sheet metal edge or a screw tip.**



⚠ WARNING:

- **In case of A-control wiring, there is high voltage potential on the S3 terminal caused by electrical circuit design that has no electrical insulation between power line and communication signal line. Therefore, please turn off the main power supply when servicing. And do not touch the S1, S2, S3 terminals when the power is energized. If isolator should be used between indoor unit and outdoor unit, please use 3-pole type.**

Never splice the power cable or the indoor-outdoor connection cable, otherwise it may result in a smoke, a fire or communication failure.

8. System control

Set the refrigerant address using the DIP switch of the outdoor unit.

SW1 Function Setting

SW1 Setting	Refrigerant address
	00
	01
	02

SW1 Setting	Refrigerant address
	03
	04
	05

Note:
a) Up to 6 units can be connected.
b) Select one single model for all units.
c) For Dip switch setting for indoor unit, refer to the indoor unit's installation manual.

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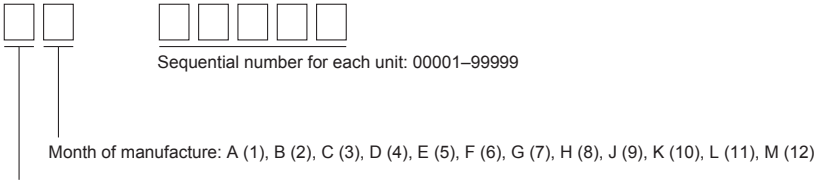
9. Specifications

Outdoor model		PUZ-WM50VHA	PUZ-WM60VAA	PUZ-WM85VAA	PUZ-WM112VAA	PUZ-WM85YAA	PUZ-WM112YAA
Power supply	V / Phase / Hz	230 / Single / 50				400 / Three / 50	
Dimensions (W × H × D)	mm	950 × 943 × 330	1050 × 1020 × 480				
Sound Power Level *1 (Heating)	dB(A)	61	58		60	58	60

*1 Measured under rated operation frequency.

10. Serial number

■ The serial number is indicated on the SPEC NAME PLATE.



EC DECLARATION OF CONFORMITY
EG-KONFORMITÄTSERKLÄRUNG
DÉCLARATION DE CONFORMITÉ CE
EG-CONFORMITEITSVERKLARING
DECLARACIÓN DE CONFORMIDAD CE
DICHIARAZIONE DI CONFORMITÀ CE

ΔΗΛΩΣΗ ΠΙΣΤΟΤΗΤΑΣ ΕΚ
DECLARAÇÃO DE CONFORMIDADE CE
EU-OVERENSSTEMMELSESERKLÆRING
EG-DEKLARATION OM ÖVERENSSTÄMMELSE
CE-ERKLÆRING OM SAMSVAR
EY-VAATIMUSTENMUKAISUUSVAKUUTUS

ES PROHLÁŠENÍ O SHODĚ
DEKLARACJA ZGODNOŚCI WE
ЕС ДЕКЛАРАЦИЯ ЗА СЪОТВЕТСТВИЕ
VYHLÁSENIE O ZHODE ES
EK MEGFELELŐSÉGI NYILATKOZAT
IZJAVA O SKLADNOSTI ES

DECLARAŢIE DE CONFORMITATE CE
EÜ VASTAVUSDEKLARATSIOON
EK ATBILSTĪBAS DEKLARĀCIJA
EB ATITIKTIES DEKLARACIJA
EC IZJAVA O SUKLADNOSTI
EZ IZJAVA O USAGLAŠENOSTI

MITSUBISHI ELECTRIC AIR CONDITIONING SYSTEMS EUROPE LTD.
NETTLEHILL ROAD, HOUSTOUN INDUSTRIAL ESTATE, LIVINGSTON, EH54 5EQ, SCOTLAND, UNITED KINGDOM

hereby declares under its sole responsibility that the air conditioners and heat pumps described below for use in residential, commercial and light-industrial environments:
erklärt hiermit auf seine alleinige Verantwortung, dass die Klimaanlagen und Wärmepumpen für das häusliche, kommerzielle und leicht-industrielle Umfeld wie unten beschrieben:
déclare par la présente et sous sa propre responsabilité que les climatiseurs et les pompes à chaleur décrits ci-dessous, destinés à un usage dans des environnements résidentiels, commerciaux et d'industrie légère :
verklaart hierbij onder eigen verantwoordelijkheid dat de voor residentiële, commerciële en licht-industriële omgevingen bestemde airconditioners en warmtepompen zoals onderstaand beschreven:
por la presente declara bajo su única responsabilidad que los acondicionadores de aire y bombas de calor descritas a continuación para su uso en entornos residenciales, comerciales y de industria ligera:
conferma con la presente, sotto la sua esclusiva responsabilità, che i condizionatori d'aria e le pompe di calore descritti di seguito e destinati all'utilizzo in ambienti residenziali, commerciali e semi-industriali:
με το παρόν πιστοποιεί με αποκλειστική της ευθύνη ότι οι τα κλιματιστικά και οι αντλίες θέρμανσης που περιγράφονται παρακάτω για χρήση σε οικιακό, επαγγελματικό και ελαφριάς βιομηχανίας περιβάλλοντα:
através da presente declara sob sua única responsabilidade que os aparelhos de ar condicionado e bombas de calor abaixo descritos para uso residencial, comercial e de indústria ligeira:
erklærer hermed under eneansvar, at de herunder beskrevne airconditionanlæg og varmepumper til brug i privat boligbyggeri, erhvervsområder og inden for let industri:
intygar härmed att luftkonditioneringarna och värmepumparna som beskrivs nedan för användning i bostäder, kommersiella miljöer och lätta industriella miljöer:
erklærer et fullstendig ansvar for undernevnte klimaanlegg og varmepumper ved bruk i boliger, samt kommersielle og lettindustrielle miljøer:
vakuuttaa täten yksinomaisella vastuullaan, että jäljempänä kuvatut asuinrakennuksiin, pienteollisuuskäyttöön ja kaupalliseen käyttöön tarkoitetut ulkoyksiköt ja lämpöpumput:
tímto na vlastní odpovědnost prohlašuje, že níže popsané klimatizační jednotky a tepelná čerpadla pro použití v obytných prostředích, komerčních prostředích a prostředích lehkého průmyslu:
niniejszym oświadcza na swoją wyłączną odpowiedzialność, że klimatyzatory i pompy ciepła opisane poniżej, są przeznaczone do zastosowań w środowisku mieszkalnym, handlowym i lekko uprzemysłowionym:
декларира на своя собствена отговорност, че климатиците и термопомпите, описани по-долу, за употреба в жилищни, търговски и леки промишлени условия:
týmto na svoju výlučnú zodpovednosť vyhlasuje, že nasledovné klimatizačné jednotky a tepelné čerpadlá určené na používanie v obytných a obchodných priestoroch a v prostredí ľahkého priemyslu:
alulírott kizárólagos felelősségére nyilatkozik, hogy az alábbi lakossági, kereskedelmi és kisipari környezetben való használatra szánt klímaberendezések és hőszivattyúk:
izjavlja pod izključno lastno odgovornostjo, da so spodaj navedene klimatske naprave in toplotne črpalke, namenjene uporabi v stanovanjskih, komercialnih in lahkoindustrijskih okoljih:
declară, prin prezenta, pe proprie răspundere, faptul că aparatele de climatizare şi pompele de căldură descrise mai jos şi destinate utilizării în medii rezidenţiale, comerciale şi din industria uşoară:
kinnitab käesolevaga oma ainuvastutusel, et allpool toodud kliimaseadmed ja soojuspumbad on mõeldud kasutamiseks elu-, äri- ja kergtööstuskeskkondades:
ar šo, vienpersoniski uzņemoties atbildību, paziņo, ka tālāk aprakstītie gaisa kondicionētāji un siltumsūkņi ir paredzēti lietošanai dzīvojamajās, komercdarbības un vieglās rūpniecības telpās.
šiuo vien tik savo atsakomybe pareiškia, kad toliau apibūdinti oro kondicionieriai ir šilumos siurbliai skirti naudoti gyvenamosiose, komercinėse ir lengvosios pramonės aplinkose:
ovime izjavljuje pod isključivom odgovornošću da su klimatizacijski uređaji i toplinske dizalice opisane u nastavku namijenjeni za upotrebu u stambenim i poslovnim okruženjima te okruženjima lake industrije:
ovim izjavljuje na svoju isključivu odgovornost da su klima-uređaji i toplotne pumpe opisane u daljem tekstu za upotrebu u stambenim, komercijalnim okruženjima i okruženjima sa lakom industrijom:

MITSUBISHI ELECTRIC, PUZ-WM50VHA*, PUZ-WM50VHA*-BS,
PUZ-WM60VAA*, PUZ-WM60VAA*-BS, PUZ-WM85VAA*, PUZ-WM85VAA*-BS, PUZ-WM112VAA*, PUZ-WM112VAA*-BS,
PUZ-WM85YAA*, PUZ-WM85YAA*-BS, PUZ-WM112YAA*, PUZ-WM112YAA*-BS
*** : , , 1, 2, 3, · · · , 9**

Note: Its serial number is on the nameplate of the product.
Hinweis: Die Seriennummer befindet sich auf dem Kennschild des Produkts.
Remarque : Le numéro de série de l'appareil se trouve sur la plaque du produit.
Opmerking: het serienummer staat op het naamplaatje van het product.
Nota: El número de serie se encuentra en la placa que contiene el nombre del producto.
Nota: il numero di serie si trova sulla targhetta del prodotto.
Σημείωση: Ο σειριακός του αριθμός βρίσκεται στην πινακίδα ονόματος του προϊόντος.
Nota: o número de série encontra-se na placa que contém o nome do produto.
Bemærk: Serienummeret står på produktets fabriksskilt.
Obs: Serienumret finns på produktens namnplåt.
Merk: Serienummeret befinner seg på navneplaten til produktet.
Huomautus: Sarjanumero on merkitty laitteen arvokilpeen.

Poznámka: Příslušné sériové číslo se nachází na štítku produktu.
Uwaga: Numer seryjny znajduje się na tabliczce znamionowej produktu.
Забележка: Серийният номер е на табелката на продукта.
Poznámka: Výrobné číslo sa nachádza na typovom štítku výrobku.
Megjegyzés: A sorozatszám a termék adattábláján található.
Opomba: serijska številka je zapisana na tipski ploščici enote.
Notă: Numărul de serie este specificat pe plăcuţa indicatoare a produsului.
Märkus. Seerianumber asub toote andmesildil.
Piezīme. Sērijas numurs ir norādīts uz ierīces datu plāksnītes.
Pastaba. Serijos numeris nurodytas gaminio vardinių duomenų lentelėje.
Napomena: serijski broj nalazi se na natpisnoj pločici proizvoda.
Napomena: Serijski broj nalazi se na nazivnoj pločici proizvoda.

Directives	Οδηγίες	Směrnice	Directive
Richtlinien	Directivas	Dyrektywy	Direktiivid
Directives	Direktiver	Директиви	Direktīvas
Richtlijnen	Direktiv	Smernice	Direktyvos
Directivas	Direktiver	Irányelvek	Direktive
Direttive	Direktiivit	Direktive	Direktīve

2014/35/EU: Low Voltage
2006/42/EC: Machinery
2014/30/EU: Electromagnetic Compatibility
2009/125/EC: Energy-related Products Directive and Regulation (EU) No. 813/2013
2011/65/EU, (EU) 2015/863 and (EU) 2017/2012: RoHS Directive
2014/68/EU: Pressure Equipment

Issued:	**1 January 2020**	**Atsushi Edayoshi**
UNITED KINGDOM		**Manager, Quality Assurance Department**

<ENGLISH>
English is original. The other languages versions are translation of the original.

⚠ CAUTION

- Refrigerant leakage may cause suffocation. Provide ventilation in accordance with EN378-1.
- Be sure to wrap insulation around the piping. Direct contact with the bare piping may result in burns or frostbite.
- Never put batteries in your mouth for any reason to avoid accidental ingestion.
- Battery ingestion may cause choking and/or poisoning.
- Install the unit on a rigid structure to prevent excessive operation sound or vibration.
- The A-weighted sound pressure level is below 70dB.
- This appliance is intended to be used by expert or trained users in shops, in light industry and on farms, or for commercial use by lay persons.

<NEDERLANDS>
Het Engels is het origineel. De andere taalversies zijn vertalingen van het origineel.

⚠ VOORZICHTIG

- Het lekken van koelvloeistof kan verstikking veroorzaken. Zorg voor ventilatie in overeenstemming met EN378-1.
- Isoleer de leidingen met isolatiemateriaal. Direct contact met de onbedekte leidingen kan leiden tot brandwonden of bevriezing.
- Stop nooit batterijen in uw mond om inslikking te voorkomen.
- Het inslikken van batterijen kan verstikking of vergiftiging veroorzaken.
- Installeer het apparaat op een stabiele structuur om overmatig lawaai of trillingen te voorkomen.
- Het niveau van de geluidsdruk ligt onder 70 dB(A).
- Dit apparaat is bedoeld voor gebruik door ervaren of opgeleide gebruikers in werkplaatsen, in de lichte industrie en op boerderijen, of voor commercieel gebruik door leken.

<DEUTSCH>
Das Original ist in Englisch. Die anderen Sprachversionen sind vom Original übersetzt.

⚠ VORSICHT

- Wenn Kältemittel austritt, kann dies zu Ersticken führen. Sorgen Sie in Übereinstimmung mit EN378-1 für Durchlüftung.
- Die Leitungen müssen isoliert werden. Direkter Kontakt mit nicht isolierten Leitungen kann zu Verbrennungen oder Erfrierungen führen.
- Nehmen Sie niemals Batterien in den Mund, um ein versehentliches Verschlucken zu vermeiden.
- Durch das Verschlucken von Batterien kann es zu Erstickungen und/oder Vergiftungen kommen.
- Installieren Sie das Gerät auf einem stabilen Untergrund, um übermäßige Betriebsgeräusche oder -schwingungen zu vermeiden.
- Der A-gewichtete Schalldruckpegel ist niedriger als 70dB.
- Dieses Gerät ist vorgesehen für die Nutzung durch Fachleute oder geschultes Personal in Werkstätten, in der Leichtindustrie und in landwirtschaftlichen Betrieben oder für die kommerzielle Nutzung durch Laien.

<ESPAÑOL>
El idioma original del documento es el inglés. Las versiones en los demás idiomas son traducciones del original.

⚠ CUIDADO

- Las pérdidas de refrigerante pueden causar asfixia. Se debe proporcionar la ventilación determinada en EN378-1.
- Asegúrese de colocar el aislante alrededor de las tuberías. El contacto directo con la tubería puede ocasionar quemaduras o congelación.
- Para evitar una ingestión accidental, no coloque las pilas en su boca bajo ningún concepto.
- La ingestión de las pilas puede causar asfixia y/o envenenamiento.
- Coloque la unidad en una estructura rígida para evitar que se produzcan sonidos o vibraciones excesivos debidos a su funcionamiento.
- El nivel de presión acústica ponderado A es inferior a 70 dB.
- Este aparato está destinado a su uso por parte de usuarios expertos o capacitados en talleres, industrias ligeras y granjas, o a su uso comercial por parte de personas no expertas.

<FRANÇAIS>
L'anglais est l'original. Les versions fournies dans d'autres langues sont des traductions de l'original.

⚠ PRECAUTION

- Une fuite de réfrigérant peut entraîner une asphyxie. Fournissez une ventilation adéquate en accord avec la norme EN378-1.
- Assurez-vous que la tuyauterie est enveloppée d'isolant. Un contact direct avec la tuyauterie nue peut entraîner des brûlures ou des engelures.
- Ne mettez jamais des piles dans la bouche pour quelque raison que ce soit pour éviter de les avaler par accident.
- Le fait d'ingérer des piles peut entraîner un étouffement et/ou un empoisonnement.
- Installez l'appareil sur une structure rigide pour prévenir un bruit de fonctionnement et une vibration excessifs.
- Le niveau de pression acoustique pondéré est en dessous de 70 dB.
- Cet appareil est conçu pour un utilisateur expert ou les utilisateurs formés en magasin, dans l'industrie légère et dans l'agriculture ou dans le commerce par le profane.

<ITALIANO>
Il testo originale è redatto in lingua Inglese. Le altre versioni linguistiche rappresentano traduzioni dell'originale.

⚠ ATTENZIONE

- Le perdite di refrigerante possono causare asfissia. Prevedere una ventilazione adeguata in conformità con la norma EN378-1.
- Accertarsi di applicare materiale isolante intorno alle tubature. Il contatto diretto con le tubature non schermate può provocare ustioni o congelamento.
- Non introdurre in nessun caso le batterie in bocca onde evitare ingestioni accidentali.
- L'ingestione delle batterie può provocare soffocamento e/o avvelenamento.
- Installare l'unità su una struttura rigida in modo da evitare rumore o vibrazioni eccessivi durante il funzionamento.
- Il livello di pressione del suono ponderato A è inferiore a 70dB.
- Questa apparecchiatura è destinata all'utilizzo da parte di utenti esperti o addestrati in negozi, industria leggera o fattorie oppure a un uso commerciale da parte di persone non esperte.

UNIT : mm
( ): WM50

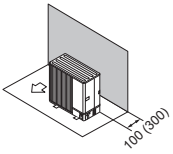


Fig. 2-6

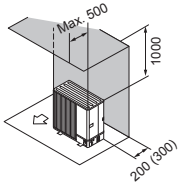


Fig. 2-7

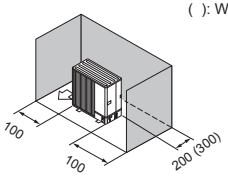


Fig. 2-8

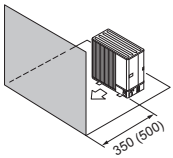


Fig. 2-9

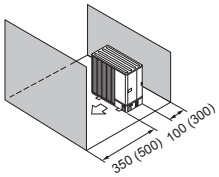


Fig. 2-10

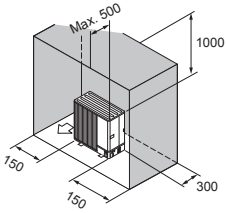


Fig. 2-11

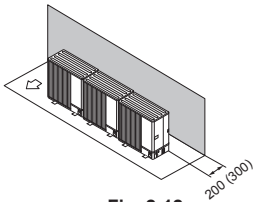


Fig. 2-12

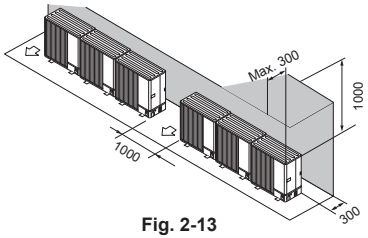


Fig. 2-13

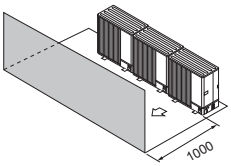


Fig. 2-14

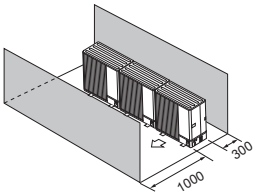


Fig. 2-15

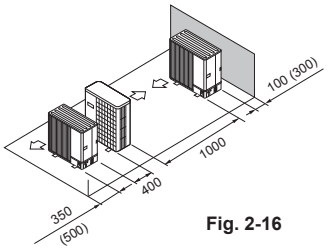


Fig. 2-16

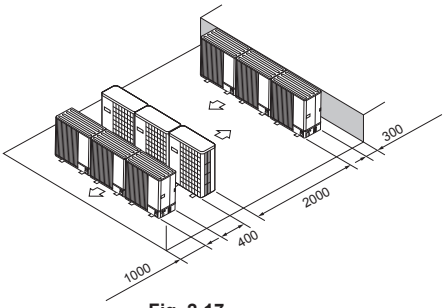


Fig. 2-17

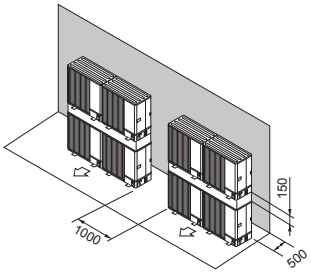


Fig. 2-18

This product is designed and intended for use in the residential, commercial and light-industrial environment.

Importer:

Mitsubishi Electric Europe B.V.
Capronilaan 46, 1119 NS, Schiphol Rijk, The Netherlands

French Branch
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German Branch
Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany

Belgian Branch
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Scandinavian Branch
Hammarbacken 14, P.O. Box 750 SE-19127, Sollentuna, Sweden

UK Branch
Travellers Lane, Hatfield, Herts., AL10 8XB, England, U.K.

Polish Branch
Krakowska 50, PL-32-083 Balice, Poland

Please be sure to put the contact address/telephone number on this manual before handing it to the customer.

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

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