Energy Statement

Flat 3, 30 Fitzjohn's Avenue

Listen. Consider. Apply. Deliver.

Client:	Florian Bernollin Flat 3, 30 Fitzjohn's Avenue London NW3 5NB
Client Lead:	
Tel:	
Email:	f_bernollin@hotmail.com
Prepared By:	MES Building Solutions Newark Beacon Beacon Hill Office Park Cafferata Way Newark NG24 2TN
Project:	Flat 3, 30 Fitzjohn's Avenue
Document Title:	Energy Statement
Date:	22/04/24
MES Contact Details:	tom@mesbuildingsolutions.co.uk
Authorised By:	Tom Reynolds
Signature:	

MES Offices

NEWARK (HEAD) OFFICE
Newark Beacon
Beacon Hill Office Park
Cafferata Way
Newark
NG24 2TN
T: 01636 653055
E: info@mesbuildingsolutions.co.uk

BIRMINGHAM
Grosvenor House
11 St Pauls Square
Birmingham
B3 1RB
T: 0121 285 2785
E: info@mesbuildingsolutions.co.uk

LONDON
45-46 Lower Marsh
London
SE1 7RG
T: 0207 033 3757
E: info@mesbuildingsolutions.co.uk

Contents Page

Appendices

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

1.0 Introduction

1.1 Executive Summary

MES have been commissioned by to provide an energy statement to address the requirements of Camden Council in relation to the proposed installation of an air source heat pump (ASHP) VRF heating & cooling system into an existing dwelling at Flat 3, 30 Fitzjohn's Avenue.

A previous application has been made under reference 2023/4516/P for the installation of an air conditioning system into the property. Following feedback on this proposal the design has been revised and this report details the updated proposal. It is now intended to install a heat-led ASHP that will heat the habitable rooms of the property via wall mounted fan coil units – an air-to-air heat pump. It is intended that this will displace space heating during the winter months from the existing gas boiler and reduce the energy and carbon dioxide emissions associated with this. These systems can also provide space cooling, so the energy modelling contained in this report fully accounts for the potential impact of this following the current Part L methodologies and conventions.

The purpose of this energy statement is to establish the predicted energy requirements for the dwelling as existing and with the proposed revisions to the fabric and heating system. It will illustrate how energy efficiency measures in conjunction with renewable generation can be used to reduce the predicted energy consumption and associated carbon dioxide emissions.

The energy and carbon reductions detailed in this report have been achieved by following the energy hierarchy, which includes:

- Calculation of estimated baseline energy consumption & CO_2 emissions using a SAP10.2 model for the dwelling as it is currently serviced
- 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

The energy modelling in this report has been undertaken using SAP10.2 following the 2021 Part L1 and the most recent carbon factors.

Table 1.1, below, shows the modelled performance based on the SAP10.2 calculations for each stage of the Energy Hierarchy. Further details can be found in Section 3 and the appendices to this report. As can be seen below, the development as proposed achieves a 33% reduction in CO_2 emissions reduction over the existing performance of the dwelling. This reduction fully accounts for the use of the ASHP for both space heating and also for any potential space cooling.

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	25,786	5.4		
Be Lean, Be Clean	23,681	5.0	0.5	**9%**
Be Green	18,850	3.6	1.3	**25%**
Cumulative on site savings	**7,026**		**1.8**	**33%**

It is also worth noting that the use of an ASHP to provide space heating will reduce the amount of energy required from the existing gas boiler. This not only reduces carbon emissions but also reduces the local emissions

of particulates and NO_x. The proposed works covered by this report, therefore, also contribute to the improvement of local air quality under policy CC4. This proposal, therefore, addresses not only the requirements of CC1 but also CC4.

1.2 Planning Policy

Policy CC1 Climate change mitigation
Camden Council requires all development (not only new-build) to minimise the effects of climate change and encourages all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

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

In addition policy CC4 of the Camden Local Plan deals with air quality. Again, this is reproduced below.

Policy CC4 Air quality

The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.

Development that involves significant demolition, construction or earthworks will also be required to assess the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan.

2.0 Description of the Development

2.1 Location

The proposed development is an existing dwelling located on the ground floor of 30 Fitzjohn's Avenue. The site location can be found in the aerial photograph below.

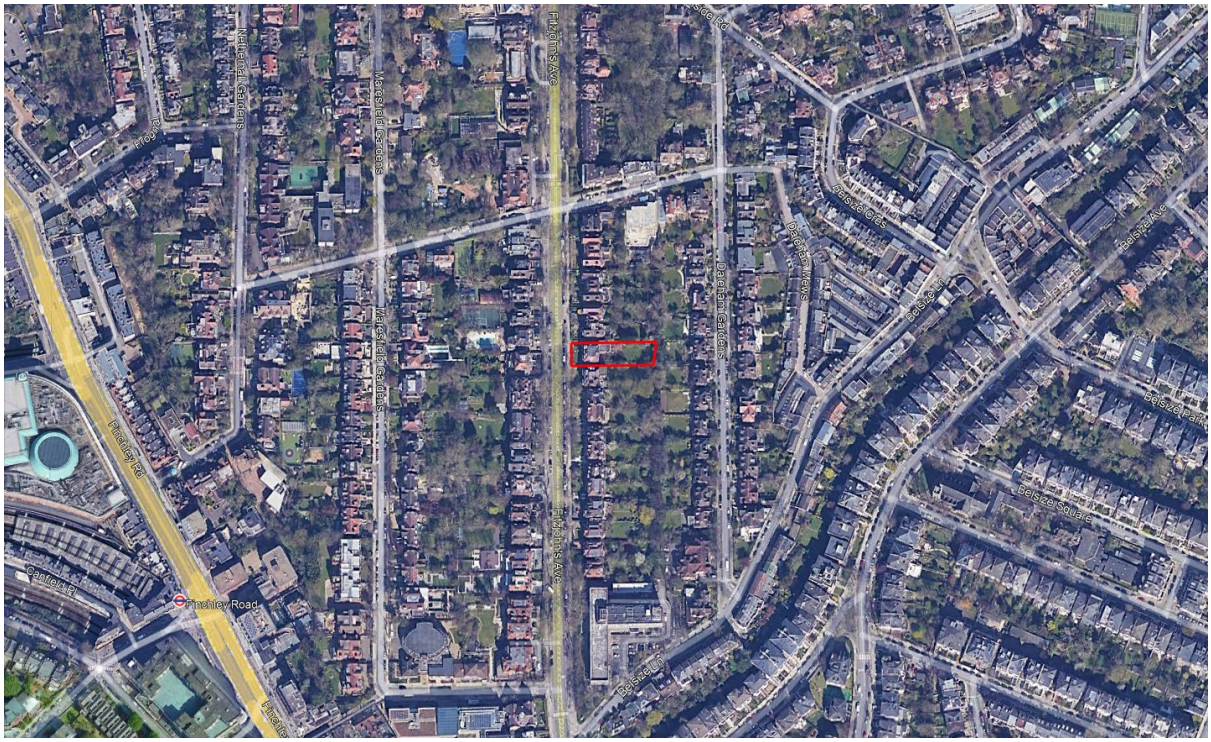


Figure 2.1: Aerial photo showing location of 30 Fitzjohn's Avenue

2.2 Details of the Development

The works proposed are the replacement of the two main front windows and the installation of an air-to-air heat pump. The heat pump will be installed to provide space heating to the main living areas of the property via fan coil units in the individual rooms. The existing combi boiler will be retained to provide space heating to the remainder of the property and also the DHW. No other works are proposed, either to the size and shape of the dwelling, to any of the thermal elements or to any other the other M&E systems (lighting, ventilation, etc.).

The existing specification of the building, both fabric and M&E has been taken from the SAP produced for the report outlining the previous application reference 2023/4516/P, so should be an accurate and up-to-date record of the specification of the dwelling prior to commencement of the ASHP installation.

Floor plans and elevations showing the proposed development can be found in Figures 2.2 & 2.3, below.

Figure 2.2 – Front elevation

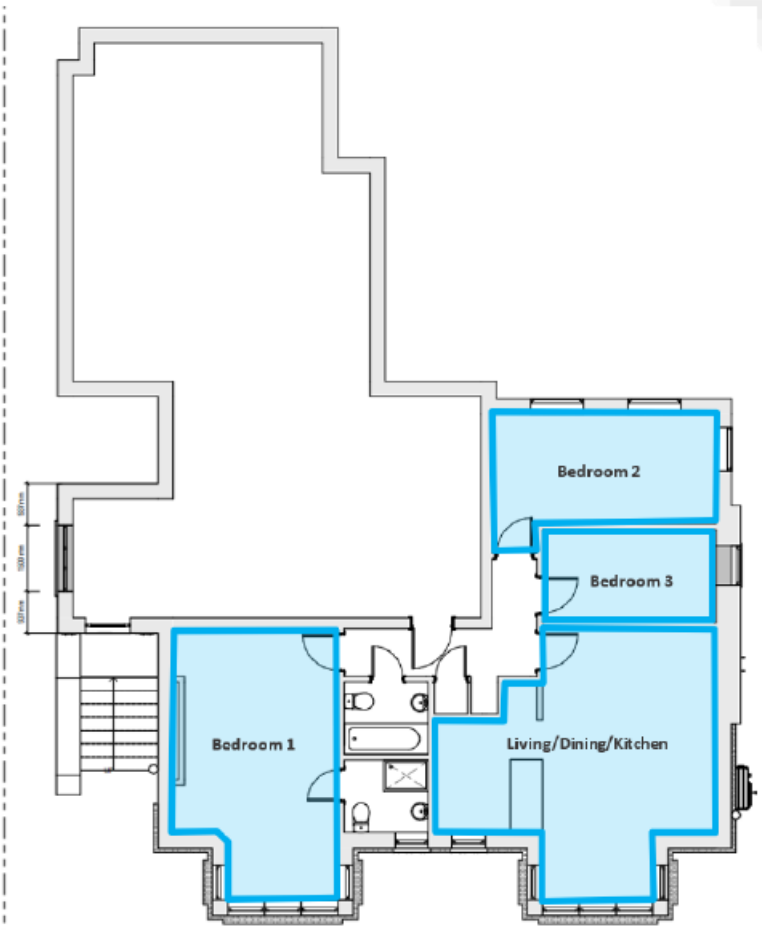


Figure 2.3 – Flat 3 floor plan

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

Development proposals should:

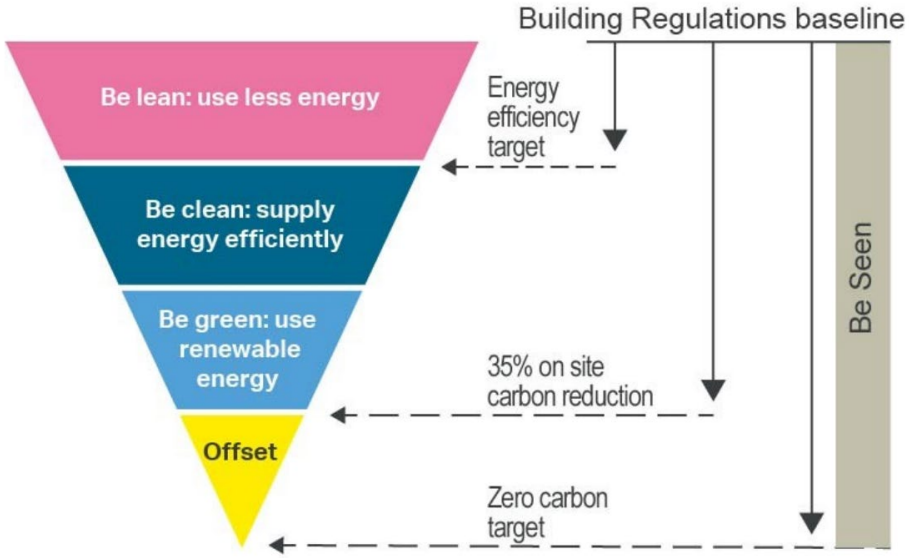


Figure 3.1: The Energy Hierarchy

- ***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.

3.2 Calculating Baseline Energy Demand

The first step is to calculate a specification in order to establish baseline emissions for the development. For this development energy modelling has been undertaken using SAP10.2 following the modelling conventions of the 2021 Part L. As this development is only for the installation of a replacement heating system into an existing dwelling there would not usually be any requirement to model the energy and carbon performance using SAP – providing the replacement system does not displace more carbon and primary energy than the existing system. As such Part L1 2021 does not set any carbon or energy performance targets for this type of development. As such the baseline performance is taken to be that of the dwelling as it is currently (pre-installation of the

proposed ASHP system) equipped and used. To ensure this is accurately represented MES have used the SAP produced for the report outlining the previous application reference 2023/4516/P, so should be an accurate reflection of the construction and specification of the existing dwelling. To calculate the Baseline carbon emissions and energy consumption the dwelling has been modelled in SAP 10.2. The results are shown in Table 3.1 below and full details (in the form of the SAP Worksheet) can be found in Appendix 1 to this report.

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	25,786	5.4		

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 only proposed works to the building fabric or services efficiencies as the replacement of the main windows to the front elevation. The full specification used for modelling at this stage of the energy hierarchy can, therefore, be found in Table 3.2, below.

Table 3.2: 'Be Lean' Specification	
Element	Specification
External Walls (solid, existing)	1.83W/m^2K
Party Roof	0.00W/m^2K
Party Floor	0.00W/m^2K
New Windows	1.40W/m^2K
Existing Windows	4.80W/m^2K
Air Permeability	n/a
Thermal Bridging	n/a
Ventilation	System 1
Lighting	LED lamps throughout (100 lumens/watt)
Space Heating	Vaillant Ecofit Pure Combi Boiler
DHW	From space heating system 2
LZC Technology	none

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 worksheet 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	25,786	5.4		
Be Lean, Be Clean	23,681	5.0	0.5	**9%**

3.4 'Be Clean' – Communal Heating & CHP

This stage of the energy hierarchy requires that the feasibility of connection to a decentralised energy source or District Heating Network be examined. In order to do this we have searched for both existing and proposed

DHNs using the London Heat Map. The results of this can be found in Figure 3.2 below. There are no proposed networks within proximity of the site, and the nearest existing network is just over 900m away.

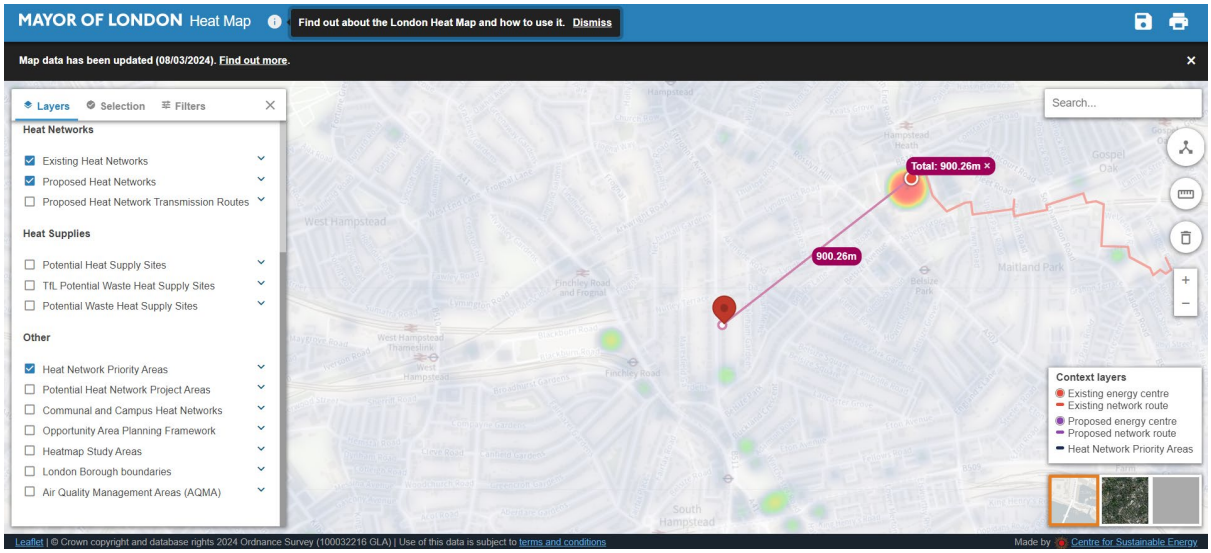


Figure 3.2: London Heat Map

Due to the lack of an existing DHN close to the site it is not considered appropriate for this development to connect to a DHN. As such there will be no improvement over the baseline achieved at this stage of the energy hierarchy as the performance remains the same as the 'Be Lean' stage.

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

This section will examine the available renewable energy generation technologies and determine which is most appropriate for the proposed development.

Available Renewable Generation 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.

Flat 3 is located on the ground floor of an existing building, which is formed of a total of four storeys. There is, therefore, no dedicated roofspace available for the specific flat under consideration. As such, this is not considered to be a suitable 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 3.4: 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. As with photovoltaic panels there is not sufficient roofspace available – as the property under consideration is a ground floor flat of an existing taller block – so this technology is not considered suitable for this development.

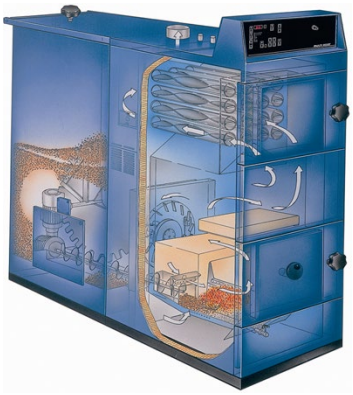
Heat Pumps

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.

A ground source heat pumps is likely to be difficult to integrate into this site as ground loops will most likely require more space than is available on site. As such, an air source heat pump that is able to displace heat from the existing gas boiler would be a much more suitable solution. As such ASHPs can be considered as suitable for 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 the difficulties of complying with clean air zone requirements.

'Be Green' Modelled Performance

As identified above, ASHPs have been identified as the most suitable technology for this development. However, key to this is the use of a VRF system that is able to provide primarily space heating. As these systems are also capable of providing cooling the effect of this has been modelled in the SAP calculation (see Appendix 3, section

8c of the SAP worksheet). This system will still provide a large improvement in the overall energy consumption and, therefore, carbon emissions.

The impact of an air-to-air ASHP VRF system has, therefore, been modelled for the 'Be Green' stage of the energy hierarchy. This has been specified in the model as a full VRF providing both space heating and cooling to the relevant rooms – no space cooling was allowed for in the baseline model, so the final 'Be Green' model is fully reflective of the impact of using this system for both space heating and cooling. The system provides a significant reduction in the energy required for space heating but some of this is offset by an increase in energy used for space cooling. All other aspects of the building specification have been kept exactly as per the baseline – so lighting, ventilation and the building fabric performance is identical in both 'Baseline' and 'Be Green' models. The existing boiler has been retained to provide space heating to the remaining rooms in the property and also to provide the DHW.

Details of the proposed ASHP system can be found in Appendix 4 to this report.

The final 'Be Green' CO_2 emissions and energy consumption figures, as taken from the SAP model, are shown in Table 3.3 below and full details (in the form of the SAP Worksheet) can be found in Appendix 2 to this report.

Table 3.5: 'Be Lean' Specification

Element	Specification
External Walls (solid, existing)	1.83W/m^{2}K
Party Roof	0.00W/m^{2}K
Party Floor	0.00W/m^{2}K
New Windows	1.40W/m^{2}K
Existing Windows	4.80W/m^{2}K
Air Permeability	n/a
Thermal Bridging	n/a
Ventilation	System 1
Lighting	LED lamps throughout (100 lumens/watt)
Space Heating 1	Mitsubishi air-to-air ASHP
Space Heating 2	Vaillant Ecofit Pure Combi Boiler
DHW	From space heating system 2
LZC Technology	none

The improved 'Be Green' carbon dioxide emissions and energy consumption figures as taken from the SAP10.2 model for the above specification are shown in Table 3.6, below, and the SAP worksheet can be found in Appendix 2.

Table 3.6: 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	25,786	5.4		
Be Lean, Be Clean	23,681	5.0	0.5	**9%**
Be Green	18,850	3.6	1.3	**25%**
Cumulative on site savings	**7,026**		**1.8**	**33%**

Appendix 1

'Baseline' SAP Worksheet

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

Full SAP Calculation Printout

Property Reference	30 Fitzjohn's Avenue	**Issued on Date**	24/04/2024
Assessment Reference	Baseline	**Prop Type Ref**	
Property	Flat 3, 30 Fitzjohn's Avenue, London, NW3 5NB		

SAP Rating	53 E	**DER**	61.56	**TER**	16.36
Environmental	47 E	**% DER < TER**			-276.28
CO_2 Emissions (t/year)	4.78	**DFEE**	247.91	**TFEE**	55.10
Compliance Check	See BREL	**% DFEE < TFEE**			-349.89
% DPER < TPER	-285.75	**DPER**	333.37	**TPER**	86.42

Assessor Details	Mr. Tom Reynolds	**Assessor ID**	8440-0005
Client			

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

---

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		88.0000 (1b)	x	3.9000 (2b)	=	343.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	343.2000	(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) =	0.0583	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8083	(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) =	0.8083	(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	1.0306	1.0103	0.9901	0.8891	0.8689	0.7679	0.7679	0.7477	0.8083	0.8689	0.9093	0.9497	(22b)
Effective ac	1.0306	1.0103	0.9902	0.8953	0.8775	0.7948	0.7948	0.7795	0.8267	0.8775	0.9134	0.9510	(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	
Existing Windows (Uw = 4.80)			30.8500	4.0268	124.2282			(27)
External Wall	145.2500	30.8500	114.4000	1.8300	209.3520	190.0000	21736.0000	(29a)
Wall to stairwell/access	44.8500		44.8500	0.9600	43.0560	190.0000	8521.5000	(29a)
Total net area of external elements Aum(A, m2)			190.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		376.6362			(33)
Party Floor 1			88.0000			30.0000	2640.0000	(32d)
Party Ceiling 1			88.0000			20.0000	1760.0000	(32b)
Internal Wall 1			200.0000			9.0000	1800.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	36457.5000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		414.2898 (35)
Thermal bridges (Default value 0.200 * total exposed area)		38.0200 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	414.6562 (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	116.7160	114.4275	112.1445	101.3926	99.3810	90.0165	90.0165	88.2823	93.6236	99.3810	103.4505	107.7050	(38)
Heat transfer coeff	531.3722	529.0837	526.8006	516.0488	514.0372	504.6727	504.6727	502.9385	508.2797	514.0372	518.1067	522.3612	(39)

Average = Sum(39)m / 12 = 516.0343

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	6.0383	6.0123	5.9864	5.8642	5.8413	5.7349	5.7349	5.7152	5.7759	5.8413	5.8876	5.9359	(40)
HLP (average)												5.8640	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5973 (42)

Hot water usage for mixer showers

101.6530	100.1253	97.8993	93.6401	90.4969	86.9916	84.9992	87.2085	89.6302	93.3938	97.7445	101.2635	(42a)

Hot water usage for baths

30.8063	30.3488	29.7045	28.5165	27.6270	26.6407	26.1079	26.7477	27.4443	28.4997	29.7121	30.7021	(42b)

Hot water usage for other uses

43.3994	41.8212	40.2430	38.6649	37.0867	35.5086	35.5086	37.0867	38.6649	40.2430	41.8212	43.3994	(42c)

Average daily hot water use (litres/day) 161.7369 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	175.8586	172.2953	167.8468	160.8215	155.2106	149.1409	146.6157	151.0429	155.7394	162.1365	169.2778	175.3650	(44)
Energy conte	278.5171	245.3462	257.9743	220.1566	208.9433	183.3861	177.3190	187.0227	192.0422	220.0177	241.1672	274.5792	(45)
Energy content (annual)										Total = Sum(45)m =		2686.4717	
Distribution loss (46)m = 0.15 x (45)m	41.7776	36.8019	38.6961	33.0235	31.3415	27.5079	26.5979	28.0534	28.8063	33.0027	36.1751	41.1869	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(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	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(64)
									Total per year (kWh/year) = Sum(64)m =			3286.4717	(64)
12Total per year (kWh/year)												3286	(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	105.3467	93.0845	98.5162	85.5308	82.2134	73.3047	71.6983	74.9248	76.1828	85.8956	92.5169	104.0373	(65)

---

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	118.7069	131.4255	118.7069	122.6638	118.7069	122.6638	118.7069	118.7069	122.6638	118.7069	122.6638	118.7069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.3498	237.7919	231.6377	218.5360	201.9975	186.4537	176.0694	173.6272	179.7815	192.8831	209.4216	224.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	(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)	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	(71)
Water heating gains (Table 5)	141.5950	138.5185	132.4142	118.7928	110.5019	101.8120	96.3687	100.7053	105.8095	115.4511	128.4957	139.8351	(72)
Total internal gains	560.6118	572.6962	547.7190	524.9528	496.1665	472.8897	453.1052	454.9996	470.2149	492.0013	525.5413	548.4677	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2000	19.6403	0.8500	0.7000	0.7700	42.1115	(76)
South	4.1500	46.7521	0.8500	0.7000	0.7700	80.0017	(78)
West	21.5000	19.6403	0.8500	0.7000	0.7700	174.1149	(80)

Solar gains	296.2281	554.0069	863.4946	1204.5753	1441.6428	1463.7257	1398.2596	1221.8135	984.5152	643.2267	364.4382	246.9429	(83)
Total gains	856.8399	1126.7031	1411.2136	1729.5281	1937.8093	1936.6154	1851.3647	1676.8131	1454.7301	1135.2280	889.9795	795.4106	(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	19.0584	19.1408	19.2237	19.6243	19.7011	20.0666	20.0666	20.1358	19.9242	19.7011	19.5463	19.3871	
alpha	2.2706	2.2761	2.2816	2.3083	2.3134	2.3378	2.3378	2.3424	2.3283	2.3134	2.3031	2.2925	
util living area	0.9955	0.9913	0.9826	0.9621	0.9225	0.8521	0.7611	0.8035	0.9203	0.9780	0.9929	0.9963	(86)
MIT	16.9456	17.2514	17.8273	18.6539	19.4643	20.1827	20.5802	20.4994	19.8818	18.8266	17.7695	16.9332	(87)
Th 2	18.0000	18.0000	18.0000	18.0015	18.0021	18.0059	18.0059	18.0068	18.0042	18.0021	18.0011	18.0003	(88)
util rest of house	0.9931	0.9866	0.9722	0.9346	0.8503	0.6576	0.3571	0.4324	0.7989	0.9565	0.9880	0.9943	(89)
MIT 2	13.8317	14.2191	14.9492	15.9770	16.9541	17.7103	17.9737	17.9516	17.4601	16.2118	14.8726	13.8057	(90)
Living area fraction									fLA = Living area / (4) =			0.3182	(91)
MIT	14.8225	15.1839	15.8649	16.8288	17.7528	18.4970	18.8030	18.7623	18.2306	17.0438	15.7944	14.8008	(92)

Temperature adjustment												-0.1500	
adjusted MIT	14.6725	15.0339	15.7149	16.6788	17.6028	18.3470	18.6530	18.6123	18.0806	16.8938	15.6444	14.6508	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9876	0.9772	0.9569	0.9131	0.8345	0.6920	0.4855	0.5491	0.8044	0.9406	0.9800	0.9897	(94)
Useful gains	846.2466	1101.0004	1350.4216	1579.3068	1617.0518	1340.1485	898.8785	920.6693	1170.1912	1067.7846	872.2182	787.1836	(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	5511.6324	5361.6955	4854.4322	4014.2184	3034.2512	1890.9841	1036.1089	1112.6293	2023.2690	3235.2260	4426.9007	5459.1024	(97)
Space heating kWh	3471.0471	2863.1871	2606.9838	1753.1363	1054.3964	0.0000	0.0000	0.0000	0.0000	1612.5764	2559.3714	3475.9076	(98a)
Space heating requirement - total per year (kWh/year)												19396.6060	
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	3471.0471	2863.1871	2606.9838	1753.1363	1054.3964	0.0000	0.0000	0.0000	0.0000	1612.5764	2559.3714	3475.9076	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												19396.6060	
Space heating per m2											(98c) / (4) =	220.4160	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3471.0471	2863.1871	2606.9838	1753.1363	1054.3964	0.0000	0.0000	0.0000	0.0000	1612.5764	2559.3714	3475.9076	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	3900.0529	3217.0642	2929.1953	1969.8161	1184.7150	0.0000	0.0000	0.0000	0.0000	1811.8835	2875.6982	3905.5141	(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	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(64)
Efficiency of water heater												80.4000	(216)
(217)m	88.1823	88.1293	88.0027	87.7495	87.1564	80.4000	80.4000	80.4000	80.4000	87.6512	88.0401	88.1922	(217)
Fuel for water heating, kWh/month	373.6306	330.6206	351.0497	307.0920	298.2020	289.4293	283.9278	295.9970	300.1957	309.1534	329.9431	369.1236	(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	19.5227	15.6619	14.1018	10.3316	7.9804	6.5201	7.2800	9.4628	12.2912	16.1268	18.2151	20.0653	(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	21793.9394	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.4000	
Water heating fuel used	3838.3648	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	157.5596	(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	25875.8639	(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	21793.9394	0.2100	4576.7273	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3838.3648	0.2100	806.0566	(264)

Space and water heating			5382.7839 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	157.5596	0.1443	22.7407 (268)
Total CO2, kg/year			5417.4539 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			61.5600 (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	21793.9394	1.1300	24627.1515	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3838.3648	1.1300	4337.3523	(278)
Space and water heating			28964.5038	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	157.5596	1.5338	241.6702	(282)
Total Primary energy kWh/year			29336.2748	(286)
Dwelling Primary energy Rate (DPER)			333.3700	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	88.0000 (1b)	x	3.9000 (2b)	=	343.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	343.2000	(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) =	0.0874 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3374 (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) =	0.3374 (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	0.4302	0.4218	0.4133	0.3712	0.3627	0.3205	0.3205	0.3121	0.3374	0.3627	0.3796	0.3965	(22b)
Effective ac	0.5925	0.5889	0.5854	0.5689	0.5658	0.5514	0.5514	0.5487	0.5569	0.5658	0.5720	0.5786	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			22.0000	1.1450	25.1908			(27)
External Wall	145.2500	22.0000	123.2500	0.1800	22.1850			(29a)
Wall to stairwell/access	44.8500		44.8500	0.1800	8.0730			(29a)
Total net area of external elements Aum(A, m2)			190.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.4488			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							424.2898	(35)
Thermal bridges (User defined value 0.050 * total exposed area)							9.5050	(36)
Point Thermal bridges					(36a) =		0.0000	
Total fabric heat loss					(33) + (36) + (36a) =		64.9538	(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	67.1083	66.7013	66.3024	64.4288	64.0782	62.4464	62.4464	62.1442	63.0749	64.0782	64.7874	65.5288	(38)
Heat transfer coeff	132.0622	131.6552	131.2563	129.3826	129.0321	127.4002	127.4002	127.0980	128.0288	129.0321	129.7413	130.4826	(39)
Average = Sum(39)m / 12 =												129.3810	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5007	1.4961	1.4915	1.4703	1.4663	1.4477	1.4477	1.4443	1.4549	1.4663	1.4743	1.4828	(40)
HLP (average)												1.4702	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5973 (42)

Hot water usage for mixer showers

	67.7687	66.7502	65.2662	62.4267	60.3312	57.9944	56.6662	58.1390	59.7535	62.2625	65.1630	67.5090 (42a)

Hot water usage for baths

	29.2660	28.8313	28.2193	27.0907	26.2457	25.3087	24.8025	25.4103	26.0721	27.0747	28.2265	29.1670 (42b)

Hot water usage for other uses

	41.2294	39.7301	38.2309	36.7316	35.2324	33.7331	33.7331	35.2324	36.7316	38.2309	39.7301	41.2294 (42c)

Average daily hot water use (litres/day) 127.0959 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	138.2640	135.3117	131.7163	126.2491	121.8093	117.0362	115.2018	118.7817	122.5572	127.5681	133.1196	137.9054	(44)
Energy conte	218.9764	192.6820	202.4431	172.8287	163.9788	143.9097	139.3266	147.0766	151.1253	173.1088	189.6533	215.9266	(45)
Energy content (annual)										Total = Sum(45)m =		2111.0357	
Distribution loss (46)m = 0.15 x (45)m													
	32.8465	28.9023	30.3665	25.9243	24.5968	21.5865	20.8990	22.0615	22.6688	25.9663	28.4480	32.3890	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	269.9353	238.7094	253.4020	222.1437	214.9377	193.2248	190.2855	198.0355	200.4404	224.0677	238.9684	266.8855	(62)
WWHRS	-30.9810	-27.3999	-28.6915	-23.7577	-22.1414	-18.9465	-17.7593	-18.8853	-19.6028	-23.1095	-26.1803	-30.4073	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	238.9543	211.3096	224.7104	198.3860	192.7963	174.2782	172.5262	179.1502	180.8376	200.9581	212.7881	236.4782	(64)
										Total per year (kWh/year) = Sum(64)m =		2423.1732	(64)
12Total per year (kWh/year)												2423	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month													
	85.5494	75.5736	80.0520	69.7943	67.2627	60.1787	59.0658	61.6427	62.5779	70.2984	75.3885	84.5353	(65)

---

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	118.7069	131.4255	118.7069	122.6638	118.7069	122.6638	118.7069	118.7069	122.6638	118.7069	122.6638	118.7069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	235.3498	237.7919	231.6377	218.5360	201.9975	186.4537	176.0694	173.6272	179.7815	192.8831	209.4216	224.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	(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)													
	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	(71)
Water heating gains (Table 5)													
	114.9857	112.4608	107.5968	96.9365	90.4068	83.5816	79.3896	82.8531	86.9138	94.4871	104.7062	113.6227	(72)
Total internal gains													
	534.0026	546.6384	522.9016	503.0965	476.0714	454.6592	436.1260	437.1473	451.3192	471.0373	501.7518	522.2553	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.7100	19.6403	0.6300	0.7000	0.7700	22.2686	(76)
South	2.9600	46.7521	0.6300	0.7000	0.7700	42.2926	(78)
West	15.3300	19.6403	0.6300	0.7000	0.7700	92.0156	(80)

Solar gains	156.5768	292.8285	456.4087	636.6856	761.9860	773.6569	739.0550	645.7957	520.3737	339.9857	192.6301	130.5264	(83)
Total gains	690.5793	839.4668	979.3103	1139.7821	1238.0574	1228.3161	1175.1810	1082.9430	971.6929	811.0230	694.3819	652.7817	(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	78.5352	78.7780	79.0174	80.1617	80.3794	81.4090	81.4090	81.6026	81.0093	80.3794	79.9401	79.4859	
alpha	6.2357	6.2519	6.2678	6.3441	6.3586	6.4273	6.4273	6.4402	6.4006	6.3586	6.3293	6.2991	
util living area													
	0.9995	0.9982	0.9924	0.9598	0.8502	0.6470	0.4748	0.5351	0.8204	0.9835	0.9985	0.9997	(86)
MIT	19.8571	20.0327	20.2968	20.6431	20.8884	20.9843	20.9981	20.9961	20.9346	20.5879	20.1602	19.8364	(87)
Th 2	19.6870	19.6904	19.6938	19.7099	19.7129	19.7269	19.7269	19.7295	19.7215	19.7129	19.7068	19.7005	(88)
util rest of house													
	0.9992	0.9970	0.9876	0.9350	0.7755	0.5274	0.3388	0.3902	0.7091	0.9687	0.9975	0.9995	(89)
MIT 2	18.3881	18.6153	18.9530	19.3866	19.6412	19.7217	19.7267	19.7289	19.6917	19.3338	18.7914	18.3717	(90)
Living area fraction										fLA = Living area / (4) =		0.3182	(91)
MIT	18.8555	19.0663	19.3806	19.7864	20.0380	20.1235	20.1312	20.1321	20.0872	19.7328	19.2269	18.8377	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8555	19.0663	19.3806	19.7864	20.0380	20.1235	20.1312	20.1321	20.0872	19.7328	19.2269	18.8377	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9962	0.9860	0.9369	0.7966	0.5660	0.3823	0.4368	0.7447	0.9690	0.9968	0.9992	(94)
Useful gains	689.8315	836.3180	965.6044	1067.8086	986.2751	695.1803	449.2980	473.0347	723.6492	785.9172	692.1868	652.2848	(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	1922.2327	1865.0668	1690.6598	1408.5074	1075.8729	703.6912	449.8782	474.3466	766.5303	1178.4233	1573.3623	1909.9700	(97)
Space heating kWh	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98a)
Space heating requirement - total per year (kWh/year)												4321.8196	
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	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4321.8196	
Space heating per m2											(98c) / (4) =	49.1116	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	992.3231	748.1810	583.8108	265.4796	72.1437	0.0000	0.0000	0.0000	0.0000	316.0439	686.6302	1012.6816	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	238.9543	211.3096	224.7104	198.3860	192.7963	174.2782	172.5262	179.1502	180.8376	200.9581	212.7881	236.4782	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.9743	86.7256	86.1857	84.8374	82.3467	80.3000	80.3000	80.3000	80.3000	85.1812	86.5714	87.0199	(217)
Fuel for water heating, kWh/month	274.7412	243.6531	260.7283	233.8426	234.1276	217.0339	214.8521	223.1011	225.2024	235.9184	245.7950	271.7520	(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	24.6650	19.7871	17.8161	13.0529	10.0824	8.2374	9.1975	11.9553	15.5287	20.3745	23.0130	25.3505	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-29.5670	-42.8363	-63.2538	-73.1190	-80.5546	-75.7907	-74.8388	-69.7966	-61.2040	-49.8522	-32.9046	-25.4279	(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	-13.3827	-28.4744	-57.2003	-86.8072	-115.6662	-116.5577	-115.2085	-97.1623	-70.6958	-41.0423	-17.9699	-10.5606	(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												4677.2939	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.3000	
Water heating fuel used												2880.7477	(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)												199.0603	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1449.8735	(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												6393.2284	(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	4677.2939	0.2100	982.2317	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2880.7477	0.2100	604.9570	(264)
Space and water heating			1587.1887	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	199.0603	0.1443	28.7306	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-679.1456	0.1340	-91.0196	
PV Unit electricity exported	-770.7279	0.1256	-96.7938	
Total			-187.8134	(269)

Total CO2, kg/year	1440.0352	(272)
EPC Target Carbon Dioxide Emission Rate (TER)	16.3600	(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	4677.2939	1.1300	5285.3421	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2880.7477	1.1300	3255.2449	(278)
Space and water heating			8540.5870	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	199.0603	1.5338	305.3253	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-679.1456	1.4953	-1015.5171	
PV Unit electricity exported	-770.7279	0.4610	-355.2882	
Total			-1370.8053	(283)
Total Primary energy kWh/year			7605.2078	(286)
Target Primary Energy Rate (TPER)			86.4200	(287)

Appendix 2

'Be Lean' SAP Worksheet

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

Full SAP Calculation Printout

Property Reference	30 Fitzjohn's Avenue	**Issued on Date**	24/04/2024
Assessment Reference	Be Lean	**Prop Type Ref**	
Property	Flat 3, 30 Fitzjohn's Avenue, London, NW3 5NB		

SAP Rating	57 D	**DER**	56.32	**TER**	16.36
Environmental	51 E	**% DER < TER**			-244.25
CO_2 Emissions (t/year)	4.36	**DFEE**	222.29	**TFEE**	55.10
Compliance Check	See BREL	**% DFEE < TFEE**			-303.40
% DPER < TPER	-253.14	**DPER**	305.18	**TPER**	86.42

Assessor Details	Mr. Tom Reynolds	**Assessor ID**	8440-0005
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	88.0000	(1b)	x 3.9000	(2b) =	343.2000	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.0000					
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	343.2000	(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) =	0.0583	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8083	(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) =	0.8083	(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	1.0306	1.0103	0.9901	0.8891	0.8689	0.7679	0.7679	0.7477	0.8083	0.8689	0.9093	0.9497	(22b)
Effective ac	1.0306	1.0103	0.9902	0.8953	0.8775	0.7948	0.7948	0.7795	0.8267	0.8775	0.9134	0.9510	(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	
New Windows (Uw = 1.40)			21.5000	1.3258	28.5038			(27)
Existing Windows (Uw = 4.80)			9.3500	4.0268	37.6510			(27)
External Wall	145.2500	30.8500	114.4000	1.8300	209.3520	190.0000	21736.0000	(29a)
Wall to stairwell/access	44.8500		44.8500	0.9600	43.0560	190.0000	8521.5000	(29a)
Total net area of external elements Aum(A, m2)			190.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		318.5628			(33)
Party Floor 1			88.0000			30.0000	2640.0000	(32d)
Party Ceiling 1			88.0000			20.0000	1760.0000	(32b)
Internal Wall 1			200.0000			9.0000	1800.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	36457.5000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		414.2898 (35)
Thermal bridges (Default value 0.200 * total exposed area)		38.0200 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	356.5828 (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	116.7160	114.4275	112.1445	101.3926	99.3810	90.0165	90.0165	88.2823	93.6236	99.3810	103.4505	107.7050	(38)

Heat transfer coeff

	473.2988	471.0103	468.7273	457.9754	455.9638	446.5993	446.5993	444.8651	450.2064	455.9638	460.0333	464.2878	(39)
Average = Sum(39)m / 12 =												457.9609	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	5.3784	5.3524	5.3264	5.2043	5.1814	5.0750	5.0750	5.0553	5.1160	5.1814	5.2277	5.2760	(40)
HLP (average)												5.2041	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.5973	(42)
Hot water usage for mixer showers													
	101.6530	100.1253	97.8993	93.6401	90.4969	86.9916	84.9992	87.2085	89.6302	93.3938	97.7445	101.2635	(42a)
Hot water usage for baths													
	30.8063	30.3488	29.7045	28.5165	27.6270	26.6407	26.1079	26.7477	27.4443	28.4997	29.7121	30.7021	(42b)
Hot water usage for other uses													
	43.3994	41.8212	40.2430	38.6649	37.0867	35.5086	35.5086	37.0867	38.6649	40.2430	41.8212	43.3994	(42c)
Average daily hot water use (litres/day)												161.7369	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	175.8586	172.2953	167.8468	160.8215	155.2106	149.1409	146.6157	151.0429	155.7394	162.1365	169.2778	175.3650	(44)
Energy conte	278.5171	245.3462	257.9743	220.1566	208.9433	183.3861	177.3190	187.0227	192.0422	220.0177	241.1672	274.5792	(45)
Energy content (annual)										Total = Sum(45)m =		2686.4717	
Distribution loss (46)m = 0.15 x (45)m													
	41.7776	36.8019	38.6961	33.0235	31.3415	27.5079	26.5979	28.0534	28.8063	33.0027	36.1751	41.1869	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(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													
	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(64)
										Total per year (kWh/year) = Sum(64)m =		3286.4717	(64)
12Total per year (kWh/year)												3286	(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													
	105.3467	93.0845	98.5162	85.5308	82.2134	73.3047	71.6983	74.9248	76.1828	85.8956	92.5169	104.0373	(65)

---

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	118.7069	131.4255	118.7069	122.6638	118.7069	122.6638	118.7069	118.7069	122.6638	118.7069	122.6638	118.7069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	235.3498	237.7919	231.6377	218.5360	201.9975	186.4537	176.0694	173.6272	179.7815	192.8831	209.4216	224.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	(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)													
	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	(71)
Water heating gains (Table 5)													
	141.5950	138.5185	132.4142	118.7928	110.5019	101.8120	96.3687	100.7053	105.8095	115.4511	128.4957	139.8351	(72)
Total internal gains													
	560.6118	572.6962	547.7190	524.9528	496.1665	472.8897	453.1052	454.9996	470.2149	492.0013	525.5413	548.4677	(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	
West	21.5000	19.6403	0.7600	0.7000	0.7700	155.6792	(80)
East	5.2000	19.6403	0.8500	0.7000	0.7700	42.1115	(76)
South	4.1500	46.7521	0.8500	0.7000	0.7700	80.0017	(78)

Solar gains	277.7924	517.9428	804.1021	1117.9549	1335.4863	1355.0556	1294.8012	1132.9442	915.4393	600.4336	341.4511	231.7823	(83)
Total gains	838.4042	1090.6389	1351.8211	1642.9077	1831.6527	1827.9452	1747.9063	1587.9439	1385.6542	1092.4349	866.9923	780.2500	(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	21.3968	21.5008	21.6055	22.1127	22.2103	22.6760	22.6760	22.7644	22.4943	22.2103	22.0138	21.8121	
alpha	2.4265	2.4334	2.4404	2.4742	2.4807	2.5117	2.5117	2.5176	2.4996	2.4807	2.4676	2.4541	
util living area													
	0.9961	0.9923	0.9844	0.9647	0.9252	0.8519	0.7558	0.7996	0.9217	0.9797	0.9938	0.9968	(86)
MIT	17.2392	17.5342	18.0800	18.8655	19.6240	20.2907	20.6489	20.5759	20.0061	19.0155	18.0207	17.2333	(87)
Th 2	18.0322	18.0349	18.0378	18.0528	18.0558	18.0713	18.0713	18.0744	18.0651	18.0558	18.0497	18.0437	(88)
util rest of house													
	0.9939	0.9879	0.9743	0.9377	0.8522	0.6542	0.3552	0.4293	0.7979	0.9586	0.9892	0.9950	(89)
MIT 2	14.1641	14.5397	15.2334	16.2174	17.1285	17.8234	18.0459	18.0301	17.5914	16.4243	15.1618	14.1541	(90)
Living area fraction										fLA = Living area / (4) =		0.3182	(91)

MIT	15.1425	15.4925	16.1391	17.0600	17.9225	18.6084	18.8741	18.8401	18.3597	17.2488	16.0714	15.1339	(92)
Temperature adjustment												-0.1500	
adjusted MIT	14.9925	15.3425	15.9891	16.9100	17.7725	18.4584	18.7241	18.6901	18.2097	17.0988	15.9214	14.9839	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9893	0.9800	0.9613	0.9194	0.8408	0.6938	0.4822	0.5464	0.8085	0.9452	0.9825	0.9912	(94)
Useful gains	829.4664	1068.7881	1299.5063	1510.4649	1539.9957	1268.2920	842.8037	867.6025	1120.2899	1032.5538	851.7993	773.3623	(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													
	5060.7549	4918.5336	4447.8175	3668.3752	2768.8349	1723.1789	948.6362	1018.7888	1850.2049	2963.2139	4058.1417	5006.8209	(97)
Space heating kWh													
	3148.0786	2587.0289	2342.3436	1553.6954	914.2563	0.0000	0.0000	0.0000	0.0000	1436.4112	2308.5665	3149.6932	(98a)
Space heating requirement - total per year (kWh/year)												17440.0738	
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													
	3148.0786	2587.0289	2342.3436	1553.6954	914.2563	0.0000	0.0000	0.0000	0.0000	1436.4112	2308.5665	3149.6932	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												17440.0738	
Space heating per m2											(98c) / (4) =	198.1827	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	3148.0786	2587.0289	2342.3436	1553.6954	914.2563	0.0000	0.0000	0.0000	0.0000	1436.4112	2308.5665	3149.6932	(98)
Space heating efficiency (main heating system 1)													
	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)													
	3537.1670	2906.7741	2631.8467	1745.7252	1027.2543	0.0000	0.0000	0.0000	0.0000	1613.9451	2593.8950	3538.9811	(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													
	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(64)
Efficiency of water heater												80.4000	(216)
(217)m	88.1071	88.0466	87.9044	87.6148	86.9415	80.4000	80.4000	80.4000	80.4000	87.5143	87.9486	88.1171	(217)
Fuel for water heating, kWh/month													
	373.9494	330.9310	351.4423	307.5640	298.9393	289.4293	283.9278	295.9970	300.1957	309.6369	330.2865	369.4382	(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	19.5227	15.6619	14.1018	10.3316	7.9804	6.5201	7.2800	9.4628	12.2912	16.1268	18.2151	20.0653	(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	19595.5886	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.4000	
Water heating fuel used	3841.7372	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	157.5596	(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	23680.8854	(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	19595.5886	0.2100	4115.0736	(261)
Total CO2 associated with community systems			0.0000	(373)

Water heating (other fuel)	3841.7372	0.2100	806.7648	(264)
Space and water heating			4921.8384	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	157.5596	0.1443	22.7407	(268)
Total CO2, kg/year			4956.5084	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			56.3200	(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	19595.5886	1.1300	22143.0151	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3841.7372	1.1300	4341.1631	(278)
Space and water heating			26484.1781	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	157.5596	1.5338	241.6702	(282)
Total Primary energy kWh/year			26855.9492	(286)
Dwelling Primary energy Rate (DPER)			305.1800	(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)	
Ground floor	88.0000	(1b)	x 3.9000	(2b) =	343.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		343.2000	(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) =	0.0874 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3374 (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) =	0.3374 (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	0.4302	0.4218	0.4133	0.3712	0.3627	0.3205	0.3205	0.3121	0.3374	0.3627	0.3796	0.3965	(22b)
Effective ac	0.5925	0.5889	0.5854	0.5689	0.5658	0.5514	0.5514	0.5487	0.5569	0.5658	0.5720	0.5786	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			22.0000	1.1450	25.1908			(27)
External Wall	145.2500	22.0000	123.2500	0.1800	22.1850			(29a)
Wall to stairwell/access	44.8500		44.8500	0.1800	8.0730			(29a)
Total net area of external elements Aum(A, m2)			190.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.4488			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							424.2898	(35)
Thermal bridges (User defined value 0.050 * total exposed area)							9.5050	(36)
Point Thermal bridges						(36a) =	0.0000	
Total fabric heat loss					(33) + (36) + (36a) =		64.9538	(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	67.1083	66.7013	66.3024	64.4288	64.0782	62.4464	62.4464	62.1442	63.0749	64.0782	64.7874	65.5288	(38)
Heat transfer coeff	132.0622	131.6552	131.2563	129.3826	129.0321	127.4002	127.4002	127.0980	128.0288	129.0321	129.7413	130.4826	(39)
Average = Sum(39)m / 12 =												129.3810	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5007	1.4961	1.4915	1.4703	1.4663	1.4477	1.4477	1.4443	1.4549	1.4663	1.4743	1.4828	(40)
HLP (average)												1.4702	

Days in mont	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5973 (42)

Hot water usage for mixer showers

	67.7687	66.7502	65.2662	62.4267	60.3312	57.9944	56.6662	58.1390	59.7535	62.2625	65.1630	67.5090 (42a)

Hot water usage for baths

	29.2660	28.8313	28.2193	27.0907	26.2457	25.3087	24.8025	25.4103	26.0721	27.0747	28.2265	29.1670 (42b)

Hot water usage for other uses

	41.2294	39.7301	38.2309	36.7316	35.2324	33.7331	33.7331	35.2324	36.7316	38.2309	39.7301	41.2294 (42c)

Average daily hot water use (litres/day) 127.0959 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.2640	135.3117	131.7163	126.2491	121.8093	117.0362	115.2018	118.7817	122.5572	127.5681	133.1196	137.9054	(44)
Energy conte	218.9764	192.6820	202.4431	172.8287	163.9788	143.9097	139.3266	147.0766	151.1253	173.1088	189.6533	215.9266	(45)
Energy content (annual)										Total = Sum(45)m =		2111.0357	
Distribution loss (46)m = 0.15 x (45)m	32.8465	28.9023	30.3665	25.9243	24.5968	21.5865	20.8990	22.0615	22.6688	25.9663	28.4480	32.3890	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	269.9353	238.7094	253.4020	222.1437	214.9377	193.2248	190.2855	198.0355	200.4404	224.0677	238.9684	266.8855	(62)
WWHRS	-30.9810	-27.3999	-28.6915	-23.7577	-22.1414	-18.9465	-17.7593	-18.8853	-19.6028	-23.1095	-26.1803	-30.4073	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	238.9543	211.3096	224.7104	198.3860	192.7963	174.2782	172.5262	179.1502	180.8376	200.9581	212.7881	236.4782	(64)
										Total per year (kWh/year) = Sum(64)m =		2423.1732	(64)
12Total per year (kWh/year)												2423	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	85.5494	75.5736	80.0520	69.7943	67.2627	60.1787	59.0658	61.6427	62.5779	70.2984	75.3885	84.5353	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	118.7069	131.4255	118.7069	122.6638	118.7069	122.6638	118.7069	118.7069	122.6638	118.7069	122.6638	118.7069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.3498	237.7919	231.6377	218.5360	201.9975	186.4537	176.0694	173.6272	179.7815	192.8831	209.4216	224.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	(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)	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	(71)
Water heating gains (Table 5)	114.9857	112.4608	107.5968	96.9365	90.4068	83.5816	79.3896	82.8531	86.9138	94.4871	104.7062	113.6227	(72)
Total internal gains	534.0026	546.6384	522.9016	503.0965	476.0714	454.6592	436.1260	437.1473	451.3192	471.0373	501.7518	522.2553	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.7100	19.6403	0.6300	0.7000	0.7700	22.2686	(76)
South	2.9600	46.7521	0.6300	0.7000	0.7700	42.2926	(78)
West	15.3300	19.6403	0.6300	0.7000	0.7700	92.0156	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	156.5768	292.8285	456.4087	636.6856	761.9860	773.6569	739.0550	645.7957	520.3737	339.9857	192.6301	130.5264	(83)
Total gains	690.5793	839.4668	979.3103	1139.7821	1238.0574	1228.3161	1175.1810	1082.9430	971.6929	811.0230	694.3819	652.7817	(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	78.5352	78.7780	79.0174	80.1617	80.3794	81.4090	81.4090	81.6026	81.0093	80.3794	79.9401	79.4859	
alpha	6.2357	6.2519	6.2678	6.3441	6.3586	6.4273	6.4273	6.4402	6.4006	6.3586	6.3293	6.2991	
util living area	0.9995	0.9982	0.9924	0.9598	0.8502	0.6470	0.4748	0.5351	0.8204	0.9835	0.9985	0.9997	(86)
MIT	19.8571	20.0327	20.2968	20.6431	20.8884	20.9843	20.9981	20.9961	20.9346	20.5879	20.1602	19.8364	(87)
Th 2	19.6870	19.6904	19.6938	19.7099	19.7129	19.7269	19.7269	19.7295	19.7215	19.7129	19.7068	19.7005	(88)
util rest of house	0.9992	0.9970	0.9876	0.9350	0.7755	0.5274	0.3388	0.3902	0.7091	0.9687	0.9975	0.9995	(89)
MIT 2	18.3881	18.6153	18.9530	19.3866	19.6412	19.7217	19.7267	19.7289	19.6917	19.3338	18.7914	18.3717	(90)
Living area fraction									fLA = Living area / (4) =			0.3182	(91)
MIT	18.8555	19.0663	19.3806	19.7864	20.0380	20.1235	20.1312	20.1321	20.0872	19.7328	19.2269	18.8377	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8555	19.0663	19.3806	19.7864	20.0380	20.1235	20.1312	20.1321	20.0872	19.7328	19.2269	18.8377	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9962	0.9860	0.9369	0.7966	0.5660	0.3823	0.4368	0.7447	0.9690	0.9968	0.9992	(94)
Useful gains	689.8315	836.3180	965.6044	1067.8086	986.2751	695.1803	449.2980	473.0347	723.6492	785.9172	692.1868	652.2848	(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	1922.2327	1865.0668	1690.6598	1408.5074	1075.8729	703.6912	449.8782	474.3466	766.5303	1178.4233	1573.3623	1909.9700	(97)
Space heating kWh	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98a)
Space heating requirement - total per year (kWh/year)												4321.8196	
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	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4321.8196	
Space heating per m2											(98c) / (4) =	49.1116	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	992.3231	748.1810	583.8108	265.4796	72.1437	0.0000	0.0000	0.0000	0.0000	316.0439	686.6302	1012.6816	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	238.9543	211.3096	224.7104	198.3860	192.7963	174.2782	172.5262	179.1502	180.8376	200.9581	212.7881	236.4782	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.9743	86.7256	86.1857	84.8374	82.3467	80.3000	80.3000	80.3000	80.3000	85.1812	86.5714	87.0199	(217)
Fuel for water heating, kWh/month	274.7412	243.6531	260.7283	233.8426	234.1276	217.0339	214.8521	223.1011	225.2024	235.9184	245.7950	271.7520	(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	24.6650	19.7871	17.8161	13.0529	10.0824	8.2374	9.1975	11.9553	15.5287	20.3745	23.0130	25.3505	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-29.5670	-42.8363	-63.2538	-73.1190	-80.5546	-75.7907	-74.8388	-69.7966	-61.2040	-49.8522	-32.9046	-25.4279	(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	-13.3827	-28.4744	-57.2003	-86.8072	-115.6662	-116.5577	-115.2085	-97.1623	-70.6958	-41.0423	-17.9699	-10.5606	(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	4677.2939	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2880.7477	(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)	199.0603	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1449.8735	(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	6393.2284	(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	4677.2939	0.2100	982.2317	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2880.7477	0.2100	604.9570	(264)
Space and water heating			1587.1887	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	199.0603	0.1443	28.7306	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-679.1456	0.1340	-91.0196	
PV Unit electricity exported	-770.7279	0.1256	-96.7938	

Total	-187.8134	(269)
Total CO2, kg/year	1440.0352	(272)
EPC Target Carbon Dioxide Emission Rate (TER)	16.3600	(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	4677.2939	1.1300	5285.3421	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2880.7477	1.1300	3255.2449	(278)
Space and water heating			8540.5870	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	199.0603	1.5338	305.3253	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-679.1456	1.4953	-1015.5171	
PV Unit electricity exported	-770.7279	0.4610	-355.2882	
Total			-1370.8053	(283)
Total Primary energy kWh/year			7605.2078	(286)
Target Primary Energy Rate (TPER)			86.4200	(287)

Appendix 3

'Be Green' SAP Worksheet

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

Full SAP Calculation Printout

Property Reference	30 Fitzjohn's Avenue	**Issued on Date**	24/04/2024
Assessment Reference	Be Green	**Prop Type Ref**	
Property	Flat 3, 30 Fitzjohn's Avenue, London, NW3 5NB		

SAP Rating	35 F	**DER**	41.21	**TER**	16.36
Environmental	64 D	**% DER < TER**			-151.89
CO_2 Emissions (t/year)	3.23	**DFEE**	222.29	**TFEE**	55.10
Compliance Check	See BREL	**% DFEE < TFEE**			-303.40
% DPER < TPER	-213.82	**DPER**	271.20	**TPER**	86.42

Assessor Details	Mr. Tom Reynolds	**Assessor ID**	8440-0005
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	88.0000	(1b)	x 3.9000	(2b) =	343.2000	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.0000					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		343.2000	(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) =	0.0583 (8)
Pressure test		No
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.8083 (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) =	0.8083 (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	1.0306	1.0103	0.9901	0.8891	0.8689	0.7679	0.7679	0.7477	0.8083	0.8689	0.9093	0.9497	(22b)
Effective ac	1.0306	1.0103	0.9902	0.8953	0.8775	0.7948	0.7948	0.7795	0.8267	0.8775	0.9134	0.9510	(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	
New Windows (Uw = 1.40)			21.5000	1.3258	28.5038			(27)
Existing Windows (Uw = 4.80)			9.3500	4.0268	37.6510			(27)
External Wall	145.2500	30.8500	114.4000	1.8300	209.3520	190.0000	21736.0000	(29a)
Wall to stairwell/access	44.8500		44.8500	0.9600	43.0560	190.0000	8521.5000	(29a)
Total net area of external elements Aum(A, m2)			190.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		318.5628			(33)
Party Floor 1			88.0000			30.0000	2640.0000	(32d)
Party Ceiling 1			88.0000			20.0000	1760.0000	(32b)
Internal Wall 1			200.0000			9.0000	1800.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	36457.5000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		414.2898 (35)
Thermal bridges (Default value 0.200 * total exposed area)		38.0200 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	356.5828 (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	116.7160	114.4275	112.1445	101.3926	99.3810	90.0165	90.0165	88.2823	93.6236	99.3810	103.4505	107.7050	(38)

Heat transfer coeff

	473.2988	471.0103	468.7273	457.9754	455.9638	446.5993	446.5993	444.8651	450.2064	455.9638	460.0333	464.2878	(39)
Average = Sum(39)m / 12 =												457.9609	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	5.3784	5.3524	5.3264	5.2043	5.1814	5.0750	5.0750	5.0553	5.1160	5.1814	5.2277	5.2760	(40)
HLP (average)												5.2041	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.5973	(42)
Hot water usage for mixer showers													
	101.6530	100.1253	97.8993	93.6401	90.4969	86.9916	84.9992	87.2085	89.6302	93.3938	97.7445	101.2635	(42a)
Hot water usage for baths													
	30.8063	30.3488	29.7045	28.5165	27.6270	26.6407	26.1079	26.7477	27.4443	28.4997	29.7121	30.7021	(42b)
Hot water usage for other uses													
	43.3994	41.8212	40.2430	38.6649	37.0867	35.5086	35.5086	37.0867	38.6649	40.2430	41.8212	43.3994	(42c)
Average daily hot water use (litres/day)												161.7369	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	175.8586	172.2953	167.8468	160.8215	155.2106	149.1409	146.6157	151.0429	155.7394	162.1365	169.2778	175.3650	(44)
Energy conte	278.5171	245.3462	257.9743	220.1566	208.9433	183.3861	177.3190	187.0227	192.0422	220.0177	241.1672	274.5792	(45)
Energy content (annual)										Total = Sum(45)m =		2686.4717	
Distribution loss (46)m = 0.15 x (45)m													
	41.7776	36.8019	38.6961	33.0235	31.3415	27.5079	26.5979	28.0534	28.8063	33.0027	36.1751	41.1869	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(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													
	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(64)
										Total per year (kWh/year) = Sum(64)m =		3286.4717	(64)
12Total per year (kWh/year)												3286	(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													
	105.3467	93.0845	98.5162	85.5308	82.2134	73.3047	71.6983	74.9248	76.1828	85.8956	92.5169	104.0373	(65)

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

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	118.7069	131.4255	118.7069	122.6638	118.7069	122.6638	118.7069	118.7069	122.6638	118.7069	122.6638	118.7069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	235.3498	237.7919	231.6377	218.5360	201.9975	186.4537	176.0694	173.6272	179.7815	192.8831	209.4216	224.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	(69)
Pumps, fans	6.0000	6.0000	6.0000	6.0000	6.0000	0.0000	0.0000	0.0000	0.0000	6.0000	6.0000	6.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	(71)
Water heating gains (Table 5)													
	141.5950	138.5185	132.4142	118.7928	110.5019	101.8120	96.3687	100.7053	105.8095	115.4511	128.4957	139.8351	(72)
Total internal gains													
	563.6118	575.6962	550.7190	527.9528	499.1665	472.8897	453.1052	454.9996	470.2149	495.0013	528.5413	551.4677	(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	
West	21.5000	19.6403	0.7600	0.7000	0.7700	155.6792	(80)
East	5.2000	19.6403	0.8500	0.7000	0.7700	42.1115	(76)
South	4.1500	46.7521	0.8500	0.7000	0.7700	80.0017	(78)

Solar gains	277.7924	517.9428	804.1021	1117.9549	1335.4863	1355.0556	1294.8012	1132.9442	915.4393	600.4336	341.4511	231.7823	(83)
Total gains	841.4042	1093.6389	1354.8211	1645.9077	1834.6527	1827.9452	1747.9063	1587.9439	1385.6542	1095.4349	869.9923	783.2500	(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	21.3968	21.5008	21.6055	22.1127	22.2103	22.6760	22.6760	22.7644	22.4943	22.2103	22.0138	21.8121	
alpha	2.4265	2.4334	2.4404	2.4742	2.4807	2.5117	2.5117	2.5176	2.4996	2.4807	2.4676	2.4541	
util living area													
	0.9961	0.9923	0.9843	0.9646	0.9249	0.8519	0.7558	0.7996	0.9217	0.9796	0.9937	0.9968	(86)
MIT	17.2408	17.5357	18.0815	18.8669	19.6253	20.2907	20.6489	20.5759	20.0061	19.0170	18.0223	17.2349	(87)
Th2 (88a)m	18.0322	18.0349	18.0378	18.0528	18.0558	18.0713	18.0713	18.0744	18.0651	18.0558	18.0497	18.0437	(88a)
ni2,m (89a)m	0.9939	0.9878	0.9742	0.9375	0.8518	0.6542	0.3552	0.4293	0.7979	0.9584	0.9891	0.9950	(89a)
MIT2 (90a)m	14.1661	14.5417	15.2353	16.2191	17.1297	17.8234	18.0459	18.0301	17.5914	16.4262	15.1638	14.1562	(90a)
Th2 (88b)m	18.0322	18.0349	18.0378	18.0528	18.0558	18.0713	18.0713	18.0744	18.0651	18.0558	18.0497	18.0437	(88b)
ni2,m (89b)m	0.9939	0.9878	0.9742	0.9375	0.8518	0.6542	0.3552	0.4293	0.7979	0.9584	0.9891	0.9950	(89b)

MIT2 (90b)m	14.1661	14.5417	15.2353	16.2191	17.1297	17.8234	18.0459	18.0301	17.5914	16.4262	15.1638	14.1562	(90b)
MIT 2	14.1661	14.5417	15.2353	16.2191	17.1297	17.8234	18.0459	18.0301	17.5914	16.4262	15.1638	14.1562	(90)
Living area fraction										fLA = Living area / (4) =		0.3182	(91)
MIT	15.1444	15.4944	16.1409	17.0616	17.9238	18.6084	18.8741	18.8401	18.3597	17.2505	16.0733	15.1358	(92)
Temperature adjustment												-0.0690	
adjusted MIT	15.0754	15.4254	16.0719	16.9926	17.8548	18.5394	18.8051	18.7711	18.2907	17.1815	16.0043	15.0668	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9894	0.9802	0.9618	0.9207	0.8438	0.7014	0.4962	0.5599	0.8141	0.9463	0.9827	0.9912	(94)
Useful gains	832.5173	1071.9716	1303.0853	1515.3251	1548.0396	1282.1851	867.3930	889.0641	1128.0698	1036.5735	854.9443	776.3957	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	5099.9771	4957.5523	4486.6156	3706.2095	2806.3452	1759.3535	984.8108	1054.8229	1886.6716	3000.9312	4096.2631	5045.3062	(97)
Space heating kWh	3174.9901	2611.1102	2368.5466	1577.4368	936.1794	0.0000	0.0000	0.0000	0.0000	1461.4821	2333.7495	3176.0695	(98a)
Space heating requirement - total per year (kWh/year)												17639.5643	
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	3174.9901	2611.1102	2368.5466	1577.4368	936.1794	0.0000	0.0000	0.0000	0.0000	1461.4821	2333.7495	3176.0695	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												17639.5643	
Space heating per m2											(98c) / (4) =	200.4496	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	4198.0333	3304.8347	3380.9749	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.4481	0.5208	0.4753	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1881.0902	1721.1721	1606.8217	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2076.7578	1986.0083	1800.0102	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	140.8807	197.0381	143.7322	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.5341	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	18.8108	26.3091	19.1915	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												64.3114	(107)

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)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.5400	(204)
Fraction of total heating from main system 2	0.4600	(205)
Efficiency of main space heating system 1 (in %)	170.0000	(206)
Efficiency of main space heating system 2 (in %)	89.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.7700	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	3174.9901	2611.1102	2368.5466	1577.4368	936.1794	0.0000	0.0000	0.0000	0.0000	1461.4821	2333.7495	3176.0695	(98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)	1008.5263	829.4115	752.3619	501.0682	297.3746	0.0000	0.0000	0.0000	0.0000	464.2355	741.3087	1008.8691	(211)
Space heating efficiency (main heating system 2)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(212)
Space heating fuel (main heating system 2)	1641.0061	1349.5626	1224.1926	815.3044	483.8680	0.0000	0.0000	0.0000	0.0000	755.3728	1206.2076	1641.5640	(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)
Space heating fuel used, main system 2												9117.0782	(213)
Water heating													
Water heating requirement	329.4760	291.3736	308.9332	269.4716	259.9022	232.7012	228.2779	237.9816	241.3573	270.9766	290.4823	325.5381	(64)
Efficiency of water heater												80.4000	(216)
(217)m	87.2815	87.1795	86.9455	86.4946	85.5556	80.4000	80.4000	80.4000	80.4000	86.3467	87.0178	87.2985	(217)
Fuel for water heating, kWh/month	377.4865	334.2227	355.3181	311.5474	303.7816	289.4293	283.9278	295.9970	300.1957	313.8240	333.8195	372.9024	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	3.9436	5.5155	4.0234	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	19.5227	15.6619	14.1018	10.3316	7.9804	6.5201	7.2800	9.4628	12.2912	16.1268	18.2151	20.0653	(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												5603.1557	(211)
Space heating fuel - main system 2												9117.0782	(213)

Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.4000	
Water heating fuel used	3872.4521	(219)
Space cooling fuel	13.4825	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	157.5596	(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	18849.7281	(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	5603.1557	0.1540	862.6325	(261)
Space heating - main system 2	9117.0782	0.2100	1914.5864	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3872.4521	0.2100	813.2149	(264)
Space and water heating			3590.4338	(265)
Space cooling	13.4825	0.1139	1.5361	(266)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	157.5596	0.1443	22.7407	(268)
Total CO2, kg/year			3626.6399	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			41.2100	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5603.1557	1.5700	8796.8405	(275)
Space heating - main system 2	9117.0782	1.1300	10302.2983	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3872.4521	1.1300	4375.8708	(278)
Space and water heating			23475.0097	(279)
Space cooling	13.4825	1.4200	19.1446	(280)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	157.5596	1.5338	241.6702	(282)
Total Primary energy kWh/year			23865.9253	(286)
Dwelling Primary energy Rate (DPER)			271.2000	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	88.0000	(1b)	x 3.9000	(2b) =	343.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	343.2000	(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) =	0.0874	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3374	(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) =	0.3374	(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	0.4302	0.4218	0.4133	0.3712	0.3627	0.3205	0.3205	0.3121	0.3374	0.3627	0.3796	0.3965	(22b)
Effective ac	0.5925	0.5889	0.5854	0.5689	0.5658	0.5514	0.5514	0.5487	0.5569	0.5658	0.5720	0.5786	(25)

---

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			22.0000	1.1450	25.1908			(27)
External Wall	145.2500	22.0000	123.2500	0.1800	22.1850			(29a)
Wall to stairwell/access	44.8500		44.8500	0.1800	8.0730			(29a)
Total net area of external elements Aum(A, m2)			190.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.4488			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		424.2898 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		9.5050 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	64.9538 (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	67.1083	66.7013	66.3024	64.4288	64.0782	62.4464	62.4464	62.1442	63.0749	64.0782	64.7874	65.5288	(38)
Heat transfer coeff	132.0622	131.6552	131.2563	129.3826	129.0321	127.4002	127.4002	127.0980	128.0288	129.0321	129.7413	130.4826	(39)
Average = Sum(39)m / 12 =												129.3810	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5007	1.4961	1.4915	1.4703	1.4663	1.4477	1.4477	1.4443	1.4549	1.4663	1.4743	1.4828	(40)
HLP (average)												1.4702	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.5973	(42)
Hot water usage for mixer showers	67.7687	66.7502	65.2662	62.4267	60.3312	57.9944	56.6662	58.1390	59.7535	62.2625	65.1630	67.5090	(42a)
Hot water usage for baths	29.2660	28.8313	28.2193	27.0907	26.2457	25.3087	24.8025	25.4103	26.0721	27.0747	28.2265	29.1670	(42b)
Hot water usage for other uses	41.2294	39.7301	38.2309	36.7316	35.2324	33.7331	33.7331	35.2324	36.7316	38.2309	39.7301	41.2294	(42c)
Average daily hot water use (litres/day)												127.0959	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.2640	135.3117	131.7163	126.2491	121.8093	117.0362	115.2018	118.7817	122.5572	127.5681	133.1196	137.9054	(44)
Energy conte	218.9764	192.6820	202.4431	172.8287	163.9788	143.9097	139.3266	147.0766	151.1253	173.1088	189.6533	215.9266	(45)
Energy content (annual)										Total = Sum(45)m =		2111.0357	
Distribution loss (46)m = 0.15 x (45)m	32.8465	28.9023	30.3665	25.9243	24.5968	21.5865	20.8990	22.0615	22.6688	25.9663	28.4480	32.3890	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	269.9353	238.7094	253.4020	222.1437	214.9377	193.2248	190.2855	198.0355	200.4404	224.0677	238.9684	266.8855	(62)
WWHRS	-30.9810	-27.3999	-28.6915	-23.7577	-22.1414	-18.9465	-17.7593	-18.8853	-19.6028	-23.1095	-26.1803	-30.4073	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	238.9543	211.3096	224.7104	198.3860	192.7963	174.2782	172.5262	179.1502	180.8376	200.9581	212.7881	236.4782	(64)
									Total per year (kWh/year) = Sum(64)m =			2423.1732	(64)
12Total per year (kWh/year)												2423	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	85.5494	75.5736	80.0520	69.7943	67.2627	60.1787	59.0658	61.6427	62.5779	70.2984	75.3885	84.5353	(65)

---

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	129.8672	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	118.7069	131.4255	118.7069	122.6638	118.7069	122.6638	118.7069	118.7069	122.6638	118.7069	122.6638	118.7069	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.3498	237.7919	231.6377	218.5360	201.9975	186.4537	176.0694	173.6272	179.7815	192.8831	209.4216	224.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	35.9867	(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)	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	-103.8937	(71)
Water heating gains (Table 5)	114.9857	112.4608	107.5968	96.9365	90.4068	83.5816	79.3896	82.8531	86.9138	94.4871	104.7062	113.6227	(72)
Total internal gains	534.0026	546.6384	522.9016	503.0965	476.0714	454.6592	436.1260	437.1473	451.3192	471.0373	501.7518	522.2553	(73)

---

6. Solar gains

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

East			3.7100		19.6403		0.6300	0.7000		0.7700		22.2686	(76)
South			2.9600		46.7521		0.6300	0.7000		0.7700		42.2926	(78)
West			15.3300		19.6403		0.6300	0.7000		0.7700		92.0156	(80)
Solar gains	156.5768	292.8285	456.4087	636.6856	761.9860	773.6569	739.0550	645.7957	520.3737	339.9857	192.6301	130.5264	(83)
Total gains	690.5793	839.4668	979.3103	1139.7821	1238.0574	1228.3161	1175.1810	1082.9430	971.6929	811.0230	694.3819	652.7817	(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	78.5352	78.7780	79.0174	80.1617	80.3794	81.4090	81.4090	81.6026	81.0093	80.3794	79.9401	79.4859	
alpha	6.2357	6.2519	6.2678	6.3441	6.3586	6.4273	6.4273	6.4402	6.4006	6.3586	6.3293	6.2991	
util living area	0.9995	0.9982	0.9924	0.9598	0.8502	0.6470	0.4748	0.5351	0.8204	0.9835	0.9985	0.9997	(86)
MIT	19.8571	20.0327	20.2968	20.6431	20.8884	20.9843	20.9981	20.9961	20.9346	20.5879	20.1602	19.8364	(87)
Th 2	19.6870	19.6904	19.6938	19.7099	19.7129	19.7269	19.7269	19.7295	19.7215	19.7129	19.7068	19.7005	(88)
util rest of house	0.9992	0.9970	0.9876	0.9350	0.7755	0.5274	0.3388	0.3902	0.7091	0.9687	0.9975	0.9995	(89)
MIT 2	18.3881	18.6153	18.9530	19.3866	19.6412	19.7217	19.7267	19.7289	19.6917	19.3338	18.7914	18.3717	(90)
Living area fraction									fLA = Living area / (4) =			0.3182	(91)
MIT	18.8555	19.0663	19.3806	19.7864	20.0380	20.1235	20.1312	20.1321	20.0872	19.7328	19.2269	18.8377	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8555	19.0663	19.3806	19.7864	20.0380	20.1235	20.1312	20.1321	20.0872	19.7328	19.2269	18.8377	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9962	0.9860	0.9369	0.7966	0.5660	0.3823	0.4368	0.7447	0.9690	0.9968	0.9992	(94)
Useful gains	689.8315	836.3180	965.6044	1067.8086	986.2751	695.1803	449.2980	473.0347	723.6492	785.9172	692.1868	652.2848	(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	1922.2327	1865.0668	1690.6598	1408.5074	1075.8729	703.6912	449.8782	474.3466	766.5303	1178.4233	1573.3623	1909.9700	(97)
Space heating kWh	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98a)
Space heating requirement - total per year (kWh/year)												4321.8196	
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	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4321.8196	
Space heating per m2											(98c) / (4) =	49.1116	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	916.9065	691.3192	539.4412	245.3031	66.6608	0.0000	0.0000	0.0000	0.0000	292.0246	634.4463	935.7178	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	992.3231	748.1810	583.8108	265.4796	72.1437	0.0000	0.0000	0.0000	0.0000	316.0439	686.6302	1012.6816	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	238.9543	211.3096	224.7104	198.3860	192.7963	174.2782	172.5262	179.1502	180.8376	200.9581	212.7881	236.4782	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.9743	86.7256	86.1857	84.8374	82.3467	80.3000	80.3000	80.3000	80.3000	85.1812	86.5714	87.0199	(217)
Fuel for water heating, kWh/month	274.7412	243.6531	260.7283	233.8426	234.1276	217.0339	214.8521	223.1011	225.2024	235.9184	245.7950	271.7520	(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	24.6650	19.7871	17.8161	13.0529	10.0824	8.2374	9.1975	11.9553	15.5287	20.3745	23.0130	25.3505	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-29.5670	-42.8363	-63.2538	-73.1190	-80.5546	-75.7907	-74.8388	-69.7966	-61.2040	-49.8522	-32.9046	-25.4279	(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	-13.3827	-28.4744	-57.2003	-86.8072	-115.6662	-116.5577	-115.2085	-97.1623	-70.6958	-41.0423	-17.9699	-10.5606	(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												4677.2939	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.3000	

Water heating fuel used	2880.7477	(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)	199.0603	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1449.8735	(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	6393.2284	(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	4677.2939	0.2100	982.2317	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2880.7477	0.2100	604.9570	(264)
Space and water heating			1587.1887	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	199.0603	0.1443	28.7306	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-679.1456	0.1340	-91.0196	
PV Unit electricity exported	-770.7279	0.1256	-96.7938	
Total			-187.8134	(269)
Total CO2, kg/year			1440.0352	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			16.3600	(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	4677.2939	1.1300	5285.3421	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2880.7477	1.1300	3255.2449	(278)
Space and water heating			8540.5870	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	199.0603	1.5338	305.3253	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-679.1456	1.4953	-1015.5171	
PV Unit electricity exported	-770.7279	0.4610	-355.2882	
Total			-1370.8053	(283)
Total Primary energy kWh/year			7605.2078	(286)
Target Primary Energy Rate (TPER)			86.4200	(287)

Appendix 4

M&E Specification Information

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

SINGLE-SPLIT WALL MOUNTED TYPE

Premium Series SRK-ZS-W

Pure White(-W)

SRK20ZS-W, SRK25ZS-W, SRK35ZS-W, SRK50ZS-W

R32 R410A SRK-ZS-W series can be selected for use both R32 and R410A outdoor unit.

Single Multi SRK-ZS-W series can be selected for use as indoor units in the combination with SCM Multi system outdoor unit.

Wireless remote control

SRC20ZS-W, SRC25ZS-W SRC35ZS-W

SRC50ZS-W

FUNCTIONS

Energy saving

Air flow

Clean operation & Filter

Comfort

Timer

Convenience

Others

SPECIFICATIONS

Indoor unit				SRK20ZS-W,-WB,-WT	SRK25ZS-W,-WB,-WT	SRK35ZS-W,-WB,-WT	SRK50ZS-W,-WB,-WT
Outdoor unit				SRC20ZS-W	SRC25ZS-W	SRC35ZS-W	SRC50ZS-W
Power source				1 Phase, 220 - 240V, 50Hz			
Nominal cooling capacity (Min~Max)			kW	2.0(0.9~2.9)	2.5(0.9~3.1)	3.5(0.9~4.0)	5.0(1.3~5.5)
Nominal heating capacity (Min~Max)			kW	2.7(0.9~4.3)	3.2(0.9~4.5)	4.0(0.9~5.0)	5.8(1.3~6.6)
Power consumption		Cooling/Heating	kW	0.44 / 0.59	0.62 / 0.74	0.89 / 0.94	1.35 / 1.56
EER/COP		Cooling/Heating		4.55 / 4.58	4.03 / 4.32	3.93 / 4.26	3.70 / 3.72
Max. running current			A	9	9	9	14.5
Sound power level	Indoor	Cooling/Heating	dB(A)	48 / 50	50 / 53	54 / 56	59 / 60
	Outdoor	Cooling/Heating		56 / 56	56 / 58	61 / 61	61 / 63
Sound pressure level	Indoor	Cooling (Hi/Me/Lo/Ulo)		34 / 25 / 22 / 19	36 / 28 / 23 / 19	40 / 30 / 26 / 19	46 / 36 / 29 / 22
		Heating (Hi/Me/Lo/Ulo)		36 / 29 / 23 / 19	39 / 30 / 24 / 19	41 / 36 / 25 / 19	46 / 37 / 31 / 24
	Outdoor	Cooling/Heating		45 / 45	46 / 46	50 / 48	51 / 52
Air flow	Indoor	Cooling (Hi/Me/Lo/Ulo)	m^3/min	9.3 / 7.0 / 5.9 / 5.0	9.9 / 8.0 / 5.9 / 5.0	11.3 / 8.7 / 7.0 / 5.0	12.1 / 9.9 / 7.4 / 5.9
		Heating (Hi/Me/Lo/Ulo)		10.0 / 8.5 / 6.5 / 5.9	11.3 / 8.7 / 6.7 / 5.9	12.3 / 11.0 / 7.0 / 5.6	13.9 / 11.2 / 9.1 / 7.4
	Outdoor	Cooling/Heating		27.4 / 23.6	27.4 / 23.6	31.5 / 27.8	32.8 / 32.8
Exterior dimensions	Indoor	HeightxWidthxDepth	mm	290 x 870 x 230			
	Outdoor			540 x 780(+62) x 290			595 x 780(+62) x 290
Net weight	Indoor / Outdoor		kg	9.5 / 31.0		9.5 / 34.5	10.0 / 36.0
Refrigerant		Type/GWP		R32 / 675			
		Charge	kg/TCO_2Eq	0.62 / 0.419		0.78 / 0.527	1.05 / 0.709
Refrigerant piping size		Liquid/Gas	ø mm	6.35(1/4") / 9.52(3/8")			6.35(1/4") / 12.7(1/2")
Refrigerant line (one way) length			m	Max. 20			Max. 25
Vertical height differences		Outdoor is higher/lower	m	Max. 10 / Max. 10			Max. 15 / Max. 15
Outdoor operating temperature range		Cooling	˚C	-15~46			
		Heating		-15~24			
Clean filter				Allergen Clear Filter x 1, Photocatalytic Washable Deodorizing Filter x 1			

- The data are measured under the following conditions(ISO-T1, H1). Cooling: Indoor temp. of 27˚CDB, 19˚CWB, and outdoor temp. of 35˚CDB. Heating: Indoor temp. of 20˚CDB, and outdoor temp. of 7˚CDB, 6˚CWB.
- Sound level indicates the value in an anechoic chamber. During operation these values are somewhat higher due to ambient conditions.
- 'tonne(s) of CO_2 equivalent' means a quantity of greenhouse gases- expressed as the product of the weight of the greenhouse gases in metric tonnes and of their global warming potential.

Low Global Warming Potential (GWP) and High energy efficiency by new refrigerant R32

The benefits of R32 GAS

- R32 has a GWP of 675, 68% less than R410A gas with GWP 2088.
- It requires 20% less charge compared to R410A gas.
- It provides 3% to 5% more energy efficiency compared to R410A gas.
- It complies F-gas phasedown.

Elegant Timeless Design

Unification of the design between ZSX and ZS series. Users can choose their favorite colour from three choices.

Black & White (-WB)

Titanium (-WT)