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DESIGN CONSULTANCY | BUILDING COMPLIANCE | BUILDING SIMULATION

ENERGY & SUSTAINABILITY STATEMENT

Single storey roof extensions to both dwellings
Parsifal House,
521 Finchley Road,
London
NW3 7BT

For:

Mr Gary Sugarman

JMDC Services Ltd. 129 Walton Lane, Nelson, Lancashire.
T. 01282 788032 | E www.jmdcservices.co.uk | W.www.jmdcservices.co.uk

ISSUE SHEET

Report Title:	Energy & Sustainability Statement		
Completed For:	Mr Gary Sugarman		
Date of First Issue:	04.03.2024		
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Completed By:	Jemma McLaughlan	Signed:	

[1] Camden Local Plan. 2017
[2] The London Plan 2021
[3] Energy Assessment Guidance – June 2022

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APPENDICES:

[1] Camden Local Plan. 2017
[2] The London Plan 2021
[3] Energy Assessment Guidance – June 2022

1. EXECUTIVE SUMMARY

This Energy & Sustainability Statement has been prepared to support the Planning Application for the single storey roof extensions to both dwellings, previously approved in application ref: 2019/5709/P.

The report will address the requirements of the Camden Local Plan, in particular, Policy CC1 Climate Change & Mitigation. The calculations and methodology used within this assessment and report structure are in accordance with the London Plan[2] and the Greater London Area (GLA) Energy Assessment Guidance[3].

In order to establish predicted figures for the development, and to accurately assess the most feasible solution for the Energy & CO^2 Reduction Strategy, each dwelling has been modelled using the governments Standard Assessment Procedure (SAP10). This is the relevant SAP calculation methodology for assessing dwelling compliance against the current version of Part L.

In accordance with the Energy Hierarchy, a baseline has been established which is derived from the Target Emission Rate (TER), minus savings from PV. After establishing this baseline, further Energy Efficiency measures are then incorporated in the Be Lean, and if applicable, the Be Clean Stage, before adding the renewable or LZC technologies in the final stage.

It is proposed that the Heating will be provided via wet underfloor heating fed by a direct acting electric boiler. The Hot Water will be provided via a Dimplex 270L Hot Water Heat Pump Cylinder.

Mechanical Ventilation with Heat Recovery will be installed, with a hybrid cooling add on, to reduce overheating in the summer months and predicted heat wave scenarios when the outside air temperate is above an acceptable level.

A 2kWp PV Array and 5kW battery per dwelling is also proposed to reduce demand further.

A Summary of the Energy & CO2 reduction can be seen below:

	ENERGY demand (kWh pa)	**CO2 Emissions** (kgCO2 p.a.)	**CO2 Reduction** (kgCO2 p.a.)	**CO2 Reduction** (%)
Target Emissions (2021) Part L (2021) Target	27316.8	4999		
BASELINE Part L (2021) Target (excluding notional PV)	28178.4	5860		
BE LEAN After Efficiency Measures	27069.2	5473.51	386.6316	**6.60%**
BE CLEAN Localized Energy & CHP	27069.2	5473.51	0	**0.00%**
BE GREEN After Renewables	15151.8	2368.8433	3104.6631	**56.72%**
TOTAL Reduction over BASELINE			3491.2947	**59.58%**
ACTUAL Reduction DER/TER			2629.7547	48.56%

The target is to achieve at least a 19% reduction in CO_2 over the Baseline and this has been exceeded.

A full breakdown of the energy demand and associated CO2 can be seen in section 5 of this report and Appendix A.

[1] Camden Local Plan. 2017
[2] The London Plan 2021
[3] Energy Assessment Guidance – June 2022

2. INTRODUCTION

This Energy & Sustainability Statement has been prepared to support the Planning Application for the single storey roof extensions to both dwellings, previously approved in application ref: 2019/5709/P.

The report will address the requirements of the Croydon Local Plan, in particular, Policy SP6 Environment and Climate Change. The calculations and methodology used within this assessment and report structure are in accordance with the London Plan[2] and the Greater London Area (GLA) Energy Assessment Guidance[3].

The report will address the requirements of the Camden Local Plan, in particular, Policy CC1 Climate Change & Mitigation. The calculations and methodology used within this assessment and report structure are in accordance with the London Plan[2] and the Greater London Area (GLA) Energy Assessment Guidance[3].

In order to establish predicted figures for the development, and to accurately assess the most feasible solution for the Energy & CO^2 Reduction Strategy, each dwelling has been modelled using the governments Standard Assessment Procedure (SAP10). This is the relevant SAP calculation methodology for assessing dwelling compliance against the current version of Part L.

In accordance with the Energy Hierarchy, a baseline has been established which is derived from the Target Emission Rate (TER), minus savings from PV. After establishing this baseline, further Energy Efficiency measures are then incorporated in the Be Lean, and if applicable, the Be Clean Stage, before adding the renewable or LZC technologies in the final stage.

We have worked with the design team with regards to how the proposed development will address the issues of sustainability, resource efficiency and climate change to reduce its overall environmental impact and running costs for future occupants.

[1] Camden Local Plan. 2017
[2] The London Plan 2021
[3] Energy Assessment Guidance – June 2022

3. THE POLICY REQUIREMENTS

The site is located in the London borough of Camden and is therefore required to meet the planning policies outlined in the Camden Local Plan[1] as well as the relevant policies of the Mayors London plan[2], which together form the statutory guidance for development within the borough.

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.

In order to establish predicted figures for the development, and to accurately assess the most feasible solution for the Energy & CO^2 Reduction Strategy, each dwelling has been modelled using the governments Standard Assessment Procedure (SAP10). This is the relevant SAP calculation methodology for assessing dwelling compliance against the current version of Part L.

Calculations should be in accordance with the Energy Hierarchy, a baseline should be established which is derived from the Target Emission Rate (TER), minus savings from PV. After establishing this baseline, further Energy Efficiency measures are then incorporated in the Be Lean, and if applicable, the Be Clean Stage, before adding the renewable or LZC technologies in the final stage.

All new residential developments are required to demonstrate a 19% CO2 reduction below Part L (2013) compliance, however as our development is being assessed under Part L 2021, the CO2 reduction is shown over compliance with the current regulations and calculations are in accordance with the new GLA methodology.

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4. LZC TECHNOLOGY FEASIBILITY

Solar Hot Water (Thermal)

Solar water heating systems are one of the more familiar renewable technologies used at the moment. They use the energy from the sun to heat water, most commonly for hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which a fluid is heated by the sun. This fluid is used to heat water that is stored in either a separate hot water cylinder or in a twin-coil hot water cylinder (the second coil is used to provide additional heating from a boiler or other heat source).

Solar Hot Water Panels provided a very minimal saving when compared to PV or ASHP therefore this was not explored further.

Wind

Wind turbines convert the kinetic energy in wind into mechanical energy that is then converted to electricity. Turbines are available in a range of sizes and designs and can either be free-standing, mounted on a building or integrated into a building structure.

Wind generation would not be suitable for this property and location.

Photovoltaic (PV) Panels

Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases of silicon. Through a process called doping, a very small amount of impurities are added to the semiconductor, which creates two different layers called n-type and p-type layers.

Certain wavelengths of light are able to ionise the silicon atoms, which separates some of the positive charges (holes) from the negative charges (electrons). The holes move into the positive or p-layer and the electrons into the negative or n-layer. These opposite charges are attracted to each other, but most of them can only re-combine by the electrons passing through an external circuit, due to an internal potential energy barrier. This flow of electrons produces a DC current.

To supplement the electric boiler and HWHP, a 2kWp PV array per dwelling will be installed to reduce electricity demand, this will be a Biosolar system that provides an integrated solution for mounting PV panels on a green or a blue roof. A 5kW battery per dwelling will also be included, to ensure efficient storage and maximise usage and savings.

Biomass Heating

Biomass is any plant-derived organic material that renews itself over a short period.

Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of wood in treated or untreated forms. The use of biomass is becoming increasingly common in some European countries (some countries such as Austria are heavily dependent on biomass).

[1] Camden Local Plan. 2017
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The environmental benefits relate to the significantly lower amounts of energy used in biomass production and processing compared to the energy released when they are burnt. This can range from a four-fold return for biodiesel to an approximate 20-fold energy return for woody biomass. Biomass-fuels can be used to produce energy on a continuous basis (unlike renewables such as wind or solar energy) and it can be an economic alternative to fossil fuels as it is a potential source of both heat and electricity.

However, Biomass systems have particular design management and maintenance requirements associated with sourcing, transportation and storage and are therefore more commonly used in commercial developments rather than domestic installations. It can be less convenient to operate than mains-supplied fuels such as natural gas and are more management intensive and require expertise in facilities management. Sources of biomass can also fluctuate, so boilers should be specified to operate on a variety of fuels without risk of overheating or tripping out.

A biomass system would be impractical for this property type, scale and location and was not explored further.

Ground Source Heat pumps

A heat pump is a device that takes up heat at a certain temperature and releases it at a higher temperature. The essential components of a heat pump are heat exchangers (through which energy is extracted and emitted) and a means of pumping heat between the exchangers. The effectiveness of the heat pump is measured by the ratio of the heating capacity to the effective power input, usually known as the coefficient of performance (COP).

Ground-source heat pumps (GSHP) extract heat from the ground. They are classified as either water-to-air or water-to-water units depending on whether the heat distribution system in the building uses air or water. Ground source heat pumps either use long shallow trenches or deep vertical boreholes to take low grade heat from the ground and then compress it to create higher temperatures.

A GSHP system was deemed not feasible for this property type, scale and location with adjacent gardens and properties within proximity and was not explored further.

Air Source Heat pumps

Air source heat pumps absorb heat from the outside air. This is usually used to heat radiators, underfloor heating systems, or warm air convectors. An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. The system performs down to air temperatures of -20°c which means that they are more than suitable for installations within the UK. Hot water and Heating can be provided 365 days a year. The hot water is produced without the aid of electrical immersions and at 55°c is more than hot enough for baths and showers. There are two main types of air source heat pump system:

An air-to-water system distributes heat via your wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard boiler system would. So they are more suitable for under-floor heating systems or larger radiators, which give out heat at lower temperatures over longer periods of time. An air-to-air system produces warm air which is circulated by fans. They are unlikely to provide you with hot water as well.

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Individual Air Source Heat Pumps were not deemed feasible for these properties, due to insufficient space within the curtilage to house the external condenser units, which would allow sufficient air flow away from windows, vents and amenity spaces.

Hot Water Cylinder Heat Pumps

Hot Water Heat Pumps or Heat pump water heaters, consist of a ducted system to supply external air to an internally installed air source heat pump that is mounted on the top of a water cylinder. The heat pump collects energy from the air and converts this into heat, which is then transferred to the water within the cylinder, creating hot water up to 60°C.

They come in various sizes, are very compact and require no external unit, meaning they are great for apartments or houses with limited external space.

We have proposed a 270L Dimplex HWHP, these units have a COP of 3.43 which greatly reduces energy demand, running costs and carbon.

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5. ENERGY STRATEGY

Each dwelling has been modelled using Elmhursts Certification FSAP10 Software, a DCLG approved software program for carrying out the Standard Assessment Procedure (SAP). SAP is the UK Government's methodology for calculating the energy performance of domestic dwellings, demonstrating compliance with the related elements of Part L of the Building Regulations, and to generate the Energy Performance Certificate for the dwelling once complete.

In order to demonstrate compliance with the provisions of AD Part L-V1 (2021 edition), the dwelling must meet all the elemental targets and requirements, set out in the approved document, as well as the minimum energy performance criterion assessed within the SAP calculation against a theoretical 'notional dwelling', which is the same size and shape as the actual dwelling and has standardised properties for fabric and services. The performance criteria are as follows:

- CO_2 Emission Rate -. The annual CO_2 emissions per unit floor area for space heating, water heating, ventilation, and lighting, minus renewable energy generated on site, in kWh/m^2/year. The Dwelling Emission Rate (DER) ≤ Target Emission Rate (TER).
- Fabric Energy Efficiency Rate - Fabric Energy Efficiency is defined as the space heating and cooling requirements per square metre of floor area. The calculated Dwelling Fabric Energy Efficiency, (DFEE), ≤ Target Fabric Energy Efficiency (TFEE).
- Primary Energy Rate – The annual primary energy per m^2, for space heating, water heating, ventilation, and lighting, minus renewable energy generated on site, in kWh/m^2/year. The Dwelling Primary Energy Rate (DPER), ≤ Target Primary Energy Rate (TPER).

STAGE 1 - BASELINE Demand & Emissions – Part L (2021) Target Emissions Rate (TER)

As the new Part L (2021) is much more stringent and the notional dwelling, from which the TER is derived, includes an energy and carbon reduction from PV, the 'TER without PV' should be obtained. This provides the TER without renewables included.

BASELINE Calculation - 1H		
Target Fabric Energy Efficiency (TFEE)	**47.13**	**kWh/Yr/m²**
Total Target Primary Energy Rate (TPER)	**56.63**	**kWh/Yr/m²**
Target Emission Rate (TER)	**10.77**	**kgCO2/m²**
Notional PV inc. in TER (-) (Row 269)	-430.77	kgCO2/yr
Total Target Emissions (excl. notional PV	2942.39	kgCO2/yr
Target Emission Rate without PV	**12.61**	**kgCO2/m²**

BASELINE Calculation - 1J		
Target Fabric Energy Efficiency (TFEE)	**46.68**	**kWh/Yr/m²**
Total Target Primary Energy Rate (TPER)	**56.07**	**kWh/Yr/m²**
Target Emission Rate (TER)	**10.66**	**kgCO2/m²**
Notional PV inc. in TER (-) (Row 269)	-430.77	kgCO2/yr
Total Target Emissions (excl. notional PV	2917.748	kgCO2/yr
Target Emission Rate without PV	**12.51**	**kgCO2/m²**

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BASELINE Calculation Specification		
	Part L1 Limiting Fabric Parameters	**BASELINE (Notional) Specification**
Exposed Floors (W/m2K):	0.18	0.13
External Walls (W/m2K):	0.26	0.18
Roof (W/m2K):	0.16	0.11
Windows & G Doors U Value (W/m2K):	1.6	1.2
Windows & G Doors G Value:	-	0.63
Roof Lights U Value (W/m2K):	2.2	1.7
Roof Lights G Value:	-	0.63
Doors (W/m2K):	1.6	1
Air Permeability:	8	5
Thermal Bridging:	-	Lengths as per dwelling with values in R2.
Ventilation:	-	Natural Vent + local extract
Heating:	-	Gas Boiler, S88.8%, W79.8%
Hot Water:	-	150L Cylinder, LF 1.39kwh/24hr
Lighting:	Minimum Efficacy 75 lm/W	185 x TFA, Efficacy 80 lm/W
		43160.5

STAGE 2 - BE LEAN Demand & Emissions

The 'Be Lean' Calculation is as per the actual calculation, with the Boiler set to notional efficiencies and no renewables. The DER must be less than the TER (without PV) as shown under the Baseline Calculation. The inclusion of MVHR, improved U Values, Air Permeability and Lighting efficacy have been included at this stage.

BE LEAN Calculation - 1H		
Dwelling Fabric Energy Efficiency (DFEE)	**46.31**	**kWh/Yr/m²**
Fabric Energy Efficiency Improvement (%)	**1.74%**	
'BE LEAN' Dwelling Emission Rate	**11.87**	**kgCO2/m²**
'BE LEAN' Total Dwelling Emissions	2769.5594	kgCO2/yr
Reduction in Dwelling Emissions from Energy Efficiency	172.8306	kgCO2/yr
Reduction in Dwelling Emissions from Energy	**5.88%**	

BE LEAN Calculation - 1J		
Dwelling Fabric Energy Efficiency (DFEE)	**45.83**	**kWh/Yr/m²**
Fabric Energy Efficiency Improvement (%)	**1.82%**	
'BE LEAN' Dwelling Emission Rate	**11.59**	**kgCO2/m²**
'BE LEAN' Total Dwelling Emissions	2703.947	kgCO2/yr
Reduction in Dwelling Emissions from Energy Efficiency	213.801	kgCO2/yr
Reduction in Dwelling Emissions from Energy	**7.33%**	

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[2] The London Plan 2021
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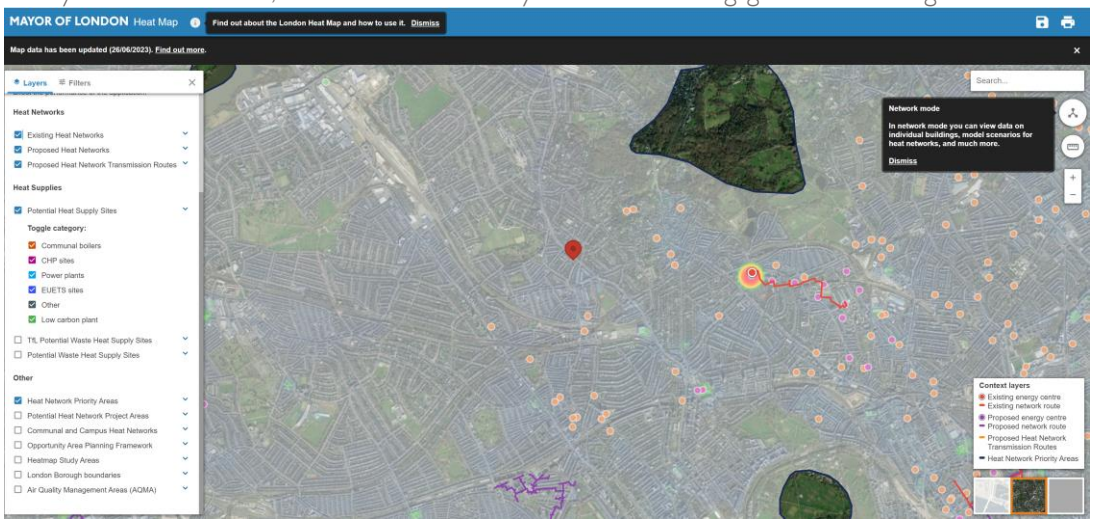
BE LEAN Calculation Specification		
	BASELINE (Notional) Specification	**BE LEAN Specification**
Exposed Floors (W/m2K):	0.13	0.09-0.13
External Walls (W/m2K):	0.18	0.12-0.15
Roof (W/m2K):	0.11	0.09-0.15
Windows & G Doors U Value (W/m2K):	1.2	1.1
Windows & G Doors G Value:	0.63	0.53 (Bed 1 & 2 - 0.3)
Roof Lights U Value (W/m2K):	1.7	1.1
Roof Lights G Value:	0.63	0.45
Doors (W/m2K):	1	1.1
Air Permeability:	5	3
Thermal Bridging:	Lengths as per dwelling with values in R2.	ACDs & Improved Psi Values
Ventilation:	Natural Vent + local extract	MVHR with Hybrid Cooling
Heating:	Gas Boiler, S88.8%, W79.8%	Gas Boiler, S88.8%, W79.8%
Hot Water:	150L Cylinder, LF 1.39kwh/24hr	270L Cylinder, LF 1.77kwh/24hr
Lighting:	185 x TFA, Efficacy 80 lm/W	Efficacy 110lm/W
	43160.5	35200

STAGE 3 - BE CLEAN Demand & Emissions

The 'Be Clean' Utilize localized energy sources. The development is within the Heat Network Priority Area, however, is not near any existing or proposed Heat Networks or transmission routes. There are also no potential heat supply sites nearby and the site is not identified as a potential heat network project area.

For this reason and that the proposal includes only 2no. dwellings, a centralised communal system was not deemed feasible. Combined Heat & Power would also not be viable for this site and was not explored further. Given the transition away from mains Gas, we have proposed a wet central heating fed by an electric boiler, with an ERP efficiency of 100% and negligible to 0 Nitrogen Oxide emissions.



Left: – Snapshot from London Heat Map

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[2] The London Plan 2021
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STAGE 4 - BE GREEN Demand & Emissions

The 'Be Green' Calculation is the actual calculation, including the LZC or Renewable Technologies.

These units have a compact 630mm diameter and low height for ease of storage. The heat pump is mounted on top of the cylinder and produces hot water efficiently by extracting heat from external air supplied via insulated ductwork. It has a very high COP of 3.43.

To supplement the electric boiler and HWHP, a 2kWp PV array per dwelling will be installed to reduce electricity demand. A 5kW battery per dwelling will also be included, to ensure efficient storage and maximise usage and savings.

BE GREEN Calculation - 1H		
'BE GREEN' Dwelling Emission Rate	**5.11**	**kgCO2/m²**
'BE GREEN' Total Dwelling Emissions	1193.0113	kgCO2/yr
Reduction in Dwelling Emissions from HWHP & PV	1576.5481	kgCO2/yr
Reduction in Dwelling Emissions from HWHP & PV (%)	**56.95%**	

BE GREEN Calculation - 1J		
'BE GREEN' Dwelling Emission Rate	**5.04**	**kgCO2/m²**
'BE GREEN' Total Dwelling Emissions	1175.832	kgCO2/yr
Reduction in Dwelling Emissions from HWHP & PV	1528.115	kgCO2/yr
Reduction in Dwelling Emissions from HWHP & PV (%)	**56.51%**	

BE GREEN Calculation Specification		
	BE LEAN Specification	**BE GREEN Parameters**
Exposed Floors (W/m2K):	0.09-0.13	0.09-0.13
External Walls (W/m2K):	0.12-0.15	0.12-0.15
Roof (W/m2K):	0.09-0.15	0.09-0.15
Windows & G Doors U Value (W/m2K):	1.1	1.1
Windows & G Doors G Value:	0.53 (Bed 1 & 2 - 0.3)	0.53 (Bed 1 & 2 - 0.3)
Roof Lights U Value (W/m2K):	1.1	1.1
Roof Lights G Value:	0.45	0.45
Doors (W/m2K):	1.1	1.1
Air Permeability:	3	3
Thermal Bridging:	ACDs & Improved Psi Values	ACDs & Improved Psi Values
Ventilation:	MVHR with Hybrid Cooling	MVHR with Hybrid Cooling
Heating:	Gas Boiler, S88.8%, W79.8%	Electric Boiler
Hot Water:	270L Cylinder, LF 1.77kwh/24hr	Dimplex 270L HWHP 1.77kwh/24hr
Lighting:	Efficacy 110lm/W	Efficacy 110lm/W
	35200	35200

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Sitewide Energy Demand & CO2 Summary

The energy demand and CO_2 reduction achieved through the stages is shown below, please see Appendices for SAP Worksheets and the full breakdown of figures.

	ENERGY demand (kWh pa)	**CO2 Emissions** (kgCO2 p.a.)	**CO2 Reduction** (kgCO2 p.a.)	**CO2 Reduction** (%)
Target Emissions (2021) Part L (2021) Target	27316.8	4999		
BASELINE Part L (2021) Target (excluding notional PV)	28178.4	5860		
BE LEAN After Efficiency Measures	27069.2	5473.51	386.6316	**6.60%**
BE CLEAN Localized Energy & CHP	27069.2	5473.51	0	**0.00%**
BE GREEN After Renewables	15151.8	2368.8433	3104.6631	**56.72%**
TOTAL Reduction over BASELINE			3491.2947	**59.58%**
ACTUAL Reduction DER/TER			2629.7547	48.56%

The Carbon reduction target of 19% has been exceeded.

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6. SUSTAINABILITY STATEMENT

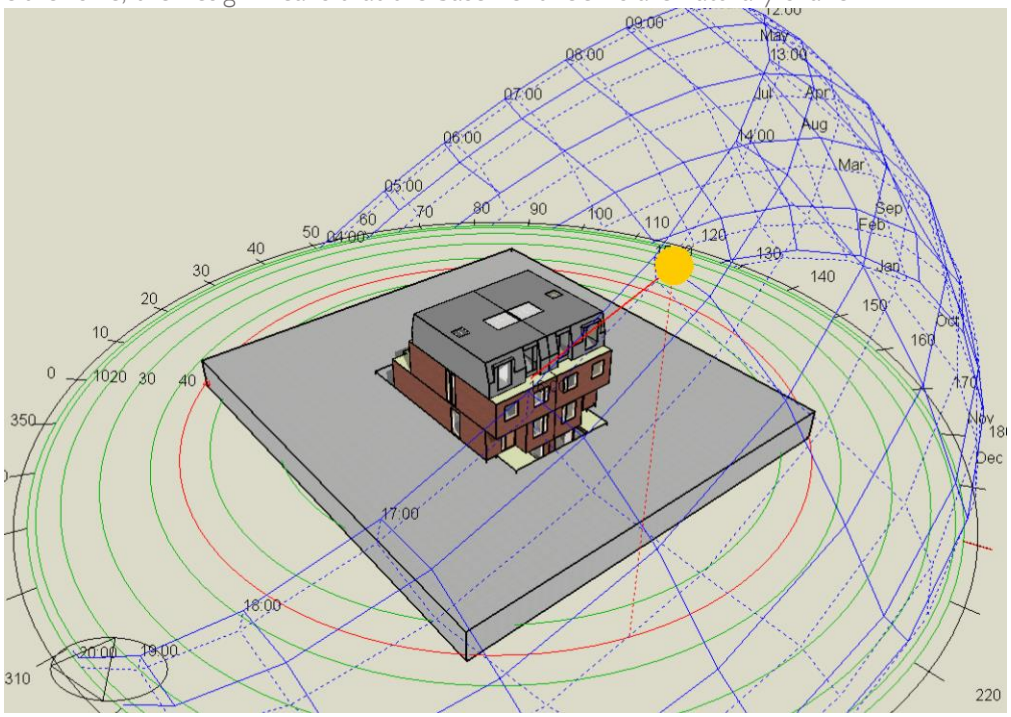
Designing for Energy Efficiency, Sustainability and Climate Change adaption

This report demonstrates that the policy requirements have been considered throughout the early design stages of this development. A fabric first design approach has been taken and this means improved insulation standards, better U Values and improved air tightness. Efficient low energy lighting is specified with an efficacy of 110Lm/W.

Mechanical Ventilation with Heat Recovery will be installed which will recover and reuse waste heat from the properties and will ensure the building is adequately and continually ventilated to support purge ventilation and help manage internal air temperatures and quality. This will help control moisture and condensation within the building fabric, improving the building life span and providing a healthier internal environment for the building occupants.

Green roofs have been incorporated into the scheme to increase biodiversity on the site and will feature indigenous vegeation local to the areas and provide habitats for flora and fauna. This will compensate for lost green areas and will assist with attenuation and run off as well as helping to mitigate the heat island effect. A Biosolar system is being proposed that provides an integrated solution for mounting PV panels on a green or a blue roof.

Dynamic Simulation Modelling has been carried on the dwellings to assess overheating risk in accordance with Part O and TM59 and so the results can steer the design from the early stages, given the site is in a high-risk part of London. The building is located within a midrise suburban area with similar buildings to either side, the design means that the basement rooms are naturally shaded.



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We have followed the cooling hierarchy and aimed to get the dwelling as close to a pass as possible through the design and natural ventilation. The window and door openings have been maximised, within the allowances of the Part O and TM59 Criteria.

External mesh microlouvers are specified to the whole dwelling, to control glare and reduce unwanted heat gains whilst still allowing a view out to occupants. G values are reduce to 0.53 for the whole dwelling and 0.3 for Bed 1 & 2, which were the two rooms most struggling to pass the criteria. Reducing the G Value has a very negative effect on the SAP Fabric Efficiency Calculation, as the notional dwelling has a G Value of 0.63 on all openings. The G values specified provided the best balance for both Overheating and SAP Results.

MVHR was specified with summer bypass to assist with the Overheating and provide free cooling. However, due to the external dry bulb temperatures in this area being above the TM59 limit in the summer months, no matter how high we increased the flow rate or lowered the G values, we were still not able to achieve a pass on the bedrooms for Criteria B whilst sleeping. Therefore, we are proposing an MVHR Hybrid Cooling system, an add on to the MVHR which will provide efficient, small scale low level cooling when required.

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
1HSECONDFLOOR	1HXBED3	0.62	18.50	Pass
1HXBASEMENT	1HXBED4	0.20	25.83	Pass
1HXBASEMENT	1HXKITCHEN	0.57	N/A	Pass
1HXFIRSTFLOOR	1HXBED1	0.19	17.33	Pass
1HXFIRSTFLOOR	1HXBED2	0.34	16.50	Pass
1HXGROUNDFLOOR	1HXLOUNGE	0.80	N/A	Pass
1HXGROUNDFLOOR	1HXSTUDY	0.92	N/A	Pass
1JSECONDFLOOR	1JXBED3	0.64	19.00	Pass
1JXBASEMENT	1JXBED4	0.23	26.00	Pass
1JXBASEMENT	1JXKITCHEN	0.57	N/A	Pass
1JXFIRSTFLOOR	1JXBED1	0.20	17.50	Pass
1JXFIRSTFLOOR	1JXBED2	0.38	17.00	Pass
1JXGROUNDFLOOR	1JXLOUNGE	0.84	N/A	Pass
1JXGROUNDFLOOR	1JXSTUDY	0.93	N/A	Pass

Materials

Consideration will be given to using materials and construction that have a low environmental impact, such as those achieving an A+ or A rated under BRE's Green Guide. Where possible, materials will be chosen that are local and responsibly sourced (such as FSC timber), recycled or reclaimed. All insulation materials will have a GWP (Global Warming Potential) of 5 or less.

Waste

The contractor will produce a Site Waste Management Plan (SWMP) to set targets and monitor to reduce waste and divert from landfill. The building will incorporate dedicated internal and external general waste and recyclable storage in accordance with the LA minimum collection requirements.

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Water

The target water use for this development is 105L/Person/Day. (110L including External) This will be achieved by the following targets:

Part G2 Water calculations		
Appliance Type:	Unit of measure:	Amount (litres) @ standard 3bar
WC (Dual flush)	Full flush volume	6
WC (Dual flush)	Part flush volume	3
Basin Taps (excluding kitchen)	Flow rate l/min	5
Kitchen taps	Flow rate l/min	5
Bath	Capacity to Overflow	160
Shower	Flow rate l/min	9
Washing Machine	Litres / kg dry load	7
Dishwasher	Litres / Place setting	1
TOTAL WATER USE (See App F)		104.57

Health & Wellbeing

Rooms have good levels of day lighting, and décor will enhance this minimising the need for artificial lighting. Materials with low VOC emissions will be used.
The Mechanical Ventilation system will provide a much healthier internal environment for the occupants, filtering the fresh air and helping to reduce allergy symptoms and other health issues such as asthma or rhinitis. The constant refreshing of the air will also remove any air pollutants or strong odours from cooking or pets that would usually linger.

With regards to greenspace, the apartments have private garden space and there are greenspaces locally.

Transport

Private car parking is provided along with electric vehicle charging points and cycle storage. The surrounding area is largely residential and therefore the location already supports the use class. There are residential amenities within walking distance in addition to well defined public transport links.

[1] Camden Local Plan. 2017
[2] The London Plan 2021
[3] Energy Assessment Guidance – June 2022

7. SCOPE & EXCLUSIONS

JMDC Services Ltd has been commissioned to carry out this Energy & Sustainability Statement, which is required as part of the Planning Application, to advise how the project could meet the Sustainability, Energy & Carbon Emission targets identified in the Planning Policies.

This report and the calculations provided are therefore for the purposes of Planning only and do NOT confirm compliance with the Building Regulations nor provide construction specifications. The calculations carried out at this stage are also NOT suitable for the formal generation and lodgement of EPCs at completion.

SAP and SBEM Calculations;

The Standard Assessment Procedure (SAP) is adopted by Government as the UK methodology for calculating the energy performance of dwellings.

SBEM is a software tool developed by BRE in support of the National Calculation Methodology (NCM), the Energy Performance of Buildings Directive (EPBD) that provides an analysis of energy consumption for non-domestic buildings.

The calculations consider a range of factors that contribute to energy efficiency:

- Materials used for construction
- Thermal insulation of the building fabric
- Solar gains through openings
- Air leakage ventilation characteristics & ventilation equipment
- Fuel, type, efficiency's and controls of the heating, cooling and hot water systems
- Lighting
- Renewable Energy Technologies

Whilst not primarily for this purpose, until benchmark data becomes available that provides a suitable estimate of the regulated emissions of different development types, Local Authorities request that SAP and SBEM calculations are carried out as a way of providing this estimation and advising how the policy requirements can be met.

The calculations and report are based on the Planning application drawings and information available at the time, which at Planning Stage is limited and based on assumptions and estimations regarding the construction, mechanical and electrical specification, and has not be based on detailed design. This may mean that once the project progresses to the subsequent stages and detailed design is carried out, this specification is proved not feasible for the project for many different reasons.

The SAP and/or SBEM calculations are carried out in accordance with regulations at the time, therefore should the regulations change prior to the next stages being carried out, this could mean that these calculations are no longer suitable.

Should the Planning application be successful, detailed SAP and/or SBEM calculations will need to be carried once the design is developed, as required to confirm compliance with the Building Regulations or for EPC purposes.

[1] Camden Local Plan. 2017

[2] The London Plan 2021

[3] Energy Assessment Guidance – June 2022

8. TERMS OF USE

This document is issued for the party which commissioned it, for this project ONLY and for the specific purposes detailed in section 8 of this report.

It should not be relied upon by any other party or used for any other purpose.

We accept no responsibility for the consequences of this document being relied upon by any other party, being used for any other purpose or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.

Please contact us is you require any further information regarding the content, scope of terms of this report.

[1] Camden Local Plan. 2017

[2] The London Plan 2021

[3] Energy Assessment Guidance – June 2022

APPENDIX A: Energy Demand & CO2 Assessment Sheets

PROJECT	**PARSIFAL - HOUSE 1H**
FLOOR AREA (m²)	**233.3**
SAP (EPC) Rating	**75C**

DEMAND FGURES

	TER	**BASELINE**	**BE LEAN**	**BE GREEN**
	Energy Demand (kWh/yr)	**Energy Demand (kWh/yr)**	**Energy Demand (kWh/yr)**	**Energy Demand (kWh/yr)**
Heating (211)	10681.22	10681.22	7875.82	6611.39
Hot Water (219)	3039.86	3039.86	4335.74	933.38
Pumps and Fans (231)	86.00	86.00	1111.73	1054.43
Cooling (221)	0.00	0.00	57.22	54.47
Lighting (232)	339.75	339.75	307.55	307.55
Energy Generated by PV (233)	430.77	0.00	0.00	-1330.01
TOTAL	**13716.1**	**14146.8**	**13688.1**	**7631.2**

BASELINE

Target Emission Rate (TER)	**Notional PV included in TER (-)**	**TOTAL Target Emissions** (kgCO2 p.a.)	**TOTAL Target Emissions excluding notional PV**	**Target Emission Rate excluding notional PV**
10.77	-430.77	2511.62	2942.39	**12.61**

BE LEAN

	Dwelling Emission Rate (DER) (BE LEAN) (kgCO2/m²) (Row 273 DER Worksheet)	**Total Dwelling Emissions (BE LEAN)** (kgCO2 p.a.)	**BE LEAN' CO2 Reduction** (kgCO2 p.a.)	**BE LEAN' CO2 Reduction** (%)
	11.87	2769.5594	172.8306	**5.88%**

BE GREEN

	Dwelling Emission Rate (DER) (ACTUAL - BE GREEN) (kgCO2/m²) (Row 273 DER Worksheet)	**Total Dwelling Emissions (ACTUAL - BE GREEN)** (kgCO2/m²) (Row 273 DER Worksheet)	**BE GREEN' CO2 Reduction** (kgCO2 p.a.)	**BE GREEN' CO2 Reduction** (%)
	5.11	1193.0113	1576.5481	**56.95%**

PROJECT	**PARSIFAL - HOUSE 1J**			
FLOOR AREA (m²)	**233.3**			
SAP (EPC) Rating	**75C**			
DEMAND FGURES				
	TER	**BASELINE**	**BE LEAN**	**BE GREEN**
	Energy Demand (kWh/yr)	**Energy Demand (kWh/yr)**	**Energy Demand (kWh/yr)**	**Energy Demand (kWh/yr)**
Heating (211)	10565.37	10565.37	7564.05	6499.22
Hot Water (219)	3040.4	3040.4	4339.4335	933.3813
Pumps and Fans (231)	86	86	1111.7302	1054.43
Cooling (221)	0.00	0.00	58.41	55.66
Lighting (232)	339.75	339.75	307.5535	307.5535
Energy Generated by PV (233)	430.77	0	0	-1329.6225
TOTAL	**13600.75**	**14031.52**	**13381.1753**	**7520.6185**

BASELINE				
Target Emission Rate (TER)	**Notional PV included in TER (-)**	**TOTAL Target Emissions** (kgCO2 p.a.)	**TOTAL Target Emissions excluding notional PV**	**Target Emission Rate excluding notional PV**
10.66	-430.77	2486.978	2917.748	**12.51**

BE LEAN				
	Dwelling Emission Rate (DER) (BE LEAN) (kgCO2/m²) (Row 273 DER Worksheet)	**Total Dwelling Emissions (BE LEAN)** (kgCO2 p.a.)	**BE LEAN' CO2 Reduction** (kgCO2 p.a.)	**BE LEAN' CO2 Reduction** (%)
	11.59	2703.947	213.801	**7.33%**

BE GREEN				
	Dwelling Emission Rate (DER) (ACTUAL - BE GREEN) (kgCO2/m²) (Row 273 DER Worksheet)	**Total Dwelling Emissions (ACTUAL - BE GREEN)** (kgCO2/m²) (Row 273 DER Worksheet)	**BE GREEN' CO2 Reduction** (kgCO2 p.a.)	**BE GREEN' CO2 Reduction** (%)
	5.04	1175.832	1528.115	**56.51%**

APPENDIX B: SAP Calculation Worksheets

Full SAP Calculation Printout

Property Reference	1Ha	**Issued on Date**	04/03/2024
Assessment Reference	1Ha	**Prop Type Ref**	1h - Left (nw)
Property	Unit 1H		

SAP Rating	75 C	**DER**	5.11	**TER**	10.77
Environmental	94 A	**% DER < TER**			52.55
CO_2 Emissions (t/year)	0.95	**DFEE**	46.31	**TFEE**	47.13
Compliance Check	See BREL	**% DFEE < TFEE**			1.74
% DPER < TPER	8.81	**DPER**	51.64	**TPER**	56.63

Assessor Details	Ms. Jemma McLaughlan	**Assessor ID**	W692-0001
Client	Gary Sugarman, Mr Gary Sugarman		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	67.3500	(1a)	x 2.6900	(2a) =	181.1715	(1a) - (3a)
Ground floor	66.1500	(1b)	x 2.7000	(2b) =	178.6050	(1b) - (3b)
First floor	53.5000	(1c)	x 3.1000	(2c) =	165.8500	(1c) - (3c)
Second floor	46.3000	(1d)	x 2.7300	(2d) =	126.3990	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	233.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	652.0255	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

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

Effective ac	0.2584	0.2549	0.2515	0.2341	0.2307	0.2133	0.2133	0.2098	0.2202	0.2307	0.2376	0.2445	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			51.5300	1.0536	54.2941			(27)
Door			3.4400	1.1000	3.7840			(26a)
Windows 0.3 (Uw = 1.10)			7.1700	1.0536	7.5546			(27)
RLH01.HOR			1.4400	1.0536	1.5172			(27a)
RLH02.HOR			4.8400	1.0536	5.0996			(27a)
FT01.BASEMENT			67.3500	0.0900	6.0615	110.0000	7408.5000	(28a)
FT05.EXPOSED			6.4100	0.1300	0.8333	20.0000	128.2000	(28b)
WT01.RETAINING	43.8700		43.8700	0.1200	5.2644	140.0000	6141.8000	(29a)
WT05.RENDER	24.9200	8.9600	15.9600	0.1500	2.3940	140.0000	2234.4000	(29a)
WT02.BRICK	126.0900	41.6200	84.4700	0.1500	12.6705	140.0000	11825.8000	(29a)
WT0.MANSARD	43.6100	11.5600	32.0500	0.1500	4.8075	9.0000	288.4500	(29a)
RT01.FLAT ROOF	67.1400	6.2800	60.8600	0.0900	5.4774	9.0000	547.7400	(30)

RT02.FT06	3.9200	3.9200	0.0900	0.3528	9.0000	35.2800	(30)
RT01a.FR DORMER	0.8500	0.8500	0.1500	0.1275	9.0000	7.6500	(30)
Total net area of external elements Aum(A, m2)		384.1600					(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		110.2384			(33)
WT03.SOLID		34.1600	0.0000	0.0000	180.0000	6148.8000	(32)
WT04.FULL FILL		90.9300	0.0000	0.0000	110.0000	10002.3000	(32)
IWT1 - Stud		271.0000			9.0000	2439.0000	(32c)
IWT2 - Blockwork		125.3200			75.0000	9399.0000	(32c)
IFT1 - Timber		159.5100			18.0000	2871.1800	(32d)
ICT1 - Timber		159.5100			9.0000	1435.5900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	60913.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		261.0960 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.8000	0.0600	0.4080
E2 Other lintels (including other steel lintels)	15.9000	0.6000	9.5400
E3 Sill	7.9350	0.0040	0.0317
E4 Jamb	48.8000	0.0020	0.0976
E22 Basement floor	16.8000	0.2200	3.6960
E5 Ground floor (normal)	9.4500	0.3200	3.0240
E20 Exposed floor (normal)	7.0000	0.3200	2.2400
E21 Exposed floor (inverted)	3.8500	0.3200	1.2320
E6 Intermediate floor within a dwelling	19.5000	0.0010	0.0195
E14 Flat roof	5.7500	0.1600	0.9200
E15 Flat roof with parapet	24.3000	0.1050	2.5515
E16 Corner (normal)	2.4000	0.1800	0.4320
E16 Corner (normal)	5.1000	0.1800	0.9180
E16 Corner (normal)	17.4000	0.0410	0.7134
E17 Corner (inverted - internal area greater than external area)	8.3000	-0.0650	-0.5395
E18 Party wall between dwellings	11.8000	0.0350	0.4130
P1 Party wall - Ground floor	12.6500	0.3200	4.0480
P2 Party wall - Intermediate floor within a dwelling	31.8300	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	0.9000	0.4800	0.4320
P5 Party wall - Roof (insulation at rafter level)	12.7800	0.4800	6.1344
E18 Party wall between dwellings	2.7000	0.2400	0.6480
R11 Upstands or kerbs of rooflights	13.6000	0.2400	3.2640
R7 Flat ceiling (inverted)	1.0000	0.1200	0.1200
E24 Eaves (insulation at ceiling level - inverted)	19.9000	0.1500	2.9850
E4 Jamb	12.4000	0.1000	1.2400
E17 Corner (inverted - internal area greater than external area)	1.0000	0.0000	0.0000
E16 Corner (normal)	15.9600	0.1800	2.8728
E18 Party wall between dwellings	5.3200	0.2400	1.2768
R9 Roof to wall (flat ceiling)	3.8500	0.3200	1.2320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		49.9502 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	160.1887 (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	55.6009	54.8545	54.1081	50.3763	49.6299	45.8981	45.8981	45.1517	47.3908	49.6299	51.1227	52.6154	(38)
Heat transfer coeff	215.7895	215.0432	214.2968	210.5650	209.8186	206.0868	206.0868	205.3404	207.5795	209.8186	211.3113	212.8041	(39)
Average = Sum(39)m / 12 =												210.3784	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9249	0.9217	0.9185	0.9026	0.8994	0.8834	0.8834	0.8802	0.8898	0.8994	0.9057	0.9121	(40)
HLP (average)												0.9018	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy											3.0452	(42)
Hot water usage for mixer showers	103.5075	101.9520	99.6853	95.3484	92.1479	88.5787	86.5499	88.7995	91.2654	95.0976	99.5277	103.1109	(42a)
Hot water usage for baths	32.4953	32.0127	31.3331	30.0800	29.1418	28.1014	27.5394	28.2142	28.9490	30.0623	31.3412	32.3855	(42b)
Hot water usage for other uses	45.8161	44.1501	42.4840	40.8180	39.1519	37.4859	37.4859	39.1519	40.8180	42.4840	44.1501	45.8161	(42c)
Average daily hot water use (litres/day)												167.2097	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	181.8189	178.1148	173.5024	166.2464	160.4416	154.1659	151.5752	156.1656	161.0324	167.6439	175.0189	181.3125	(44)
Energy conte	287.9567	253.6331	266.6668	227.5830	215.9852	189.5650	183.3171	193.3657	198.5690	227.4912	249.3465	283.8916	(45)
Energy content (annual)										Total = Sum(45)m =		2777.3710	
Distribution loss (46)m = 0.15 x (45)m	43.1935	38.0450	40.0000	34.1375	32.3978	28.4347	27.4976	29.0049	29.7854	34.1237	37.4020	42.5837	(46)
Water storage loss:													
Store volume												269.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9558	(55)
Total storage loss	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(56)
If cylinder contains dedicated solar storage	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	317.5865	280.3955	296.2966	256.2570	245.6150	218.2390	212.9469	222.9955	227.2430	257.1210	278.0205	313.5214	(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	317.5865	280.3955	296.2966	256.2570	245.6150	218.2390	212.9469	222.9955	227.2430	257.1210	278.0205	313.5214	(64)
										Total per year (kWh/year) = Sum(64)m =		3126.2380	(64)
12Total per year (kWh/year)												3126	(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	95.7456	84.3330	88.6667	75.6714	71.8151	63.0304	60.9529	64.2941	66.0242	75.6408	82.9077	94.3939	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	202.6052	224.3129	202.6052	209.3587	202.6052	209.3587	202.6052	202.6052	209.3587	202.6052	209.3587	202.6052	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.6875	405.8558	395.3519	372.9904	344.7630	318.2332	300.5097	296.3414	306.8453	329.2068	357.4342	383.9640	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	(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)													
	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	(71)
Water heating gains (Table 5)													
	128.6903	125.4955	119.1757	105.0991	96.5256	87.5422	81.9260	86.4168	91.7003	101.6678	115.1496	126.8736	(72)
Total internal gains													
	804.6614	827.3425	788.8111	759.1265	715.5721	683.8124	653.7192	654.0417	676.5826	705.1581	753.6208	785.1211	(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	
Northeast	28.5100	11.2829	0.5700	0.7000	0.7700	88.9458	(75)
Southeast	2.8800	36.7938	0.5700	0.7000	0.7700	29.3004	(77)
Southwest	14.2400	36.7938	0.5700	0.7000	0.7700	144.8742	(79)
Northwest	5.9000	11.2829	0.5700	0.7000	0.7700	18.4069	(81)
Northeast	6.2800	26.0000	0.4500	0.7000	1.0000	46.2899	(82)
Northeast	3.4500	11.2829	0.3000	0.7000	0.7700	5.6649	(75)
Southwest	3.7200	36.7938	0.3000	0.7000	0.7700	19.9191	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	353.4013	656.8048	1037.7545	1508.2451	1884.6189	1954.8078	1849.9149	1557.6784	1199.6019	764.0436	433.4376	295.7877	(83)
Total gains	1158.0627	1484.1473	1826.5656	2267.3716	2600.1911	2638.6202	2503.6341	2211.7201	1876.1845	1469.2018	1187.0585	1080.9088	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	78.4119	78.6841	78.9581	80.3575	80.6433	82.1036	82.1036	82.4020	81.5132	80.6433	80.0737	79.5120	
alpha	6.2275	6.2456	6.2639	6.3572	6.3762	6.4736	6.4736	6.4935	6.4342	6.3762	6.3382	6.3008	
util living area													
	0.9994	0.9971	0.9849	0.9089	0.7163	0.4970	0.3619	0.4261	0.7267	0.9723	0.9981	0.9996	(86)
MIT	20.1021	20.2627	20.4963	20.7816	20.9204	20.9494	20.9517	20.9514	20.9277	20.6888	20.3414	20.0839	(87)
Th 2	20.1463	20.1491	20.1518	20.1653	20.1681	20.1817	20.1817	20.1844	20.1762	20.1681	20.1626	20.1572	(88)
util rest of house													
	0.9992	0.9961	0.9797	0.8828	0.6630	0.4348	0.2947	0.3511	0.6542	0.9593	0.9973	0.9995	(89)
MIT 2	19.0760	19.2837	19.5822	19.9371	20.0819	20.1187	20.1200	20.1227	20.0991	19.8382	19.3960	19.0616	(90)
Living area fraction										fLA = Living area / (4) =		0.1586	(91)
MIT	19.2387	19.4390	19.7272	20.0711	20.2149	20.2505	20.2519	20.2542	20.2305	19.9731	19.5459	19.2237	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0887	19.2890	19.5772	19.9211	20.0649	20.1005	20.1019	20.1042	20.0805	19.8231	19.3959	19.0737	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9947	0.9750	0.8739	0.6561	0.4286	0.2882	0.3437	0.6452	0.9522	0.9962	0.9992	(94)
Useful gains	1156.7239	1476.2576	1780.9731	1981.4614	1705.8662	1130.8457	721.5332	760.1275	1210.5334	1398.9120	1182.5459	1080.0913	(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													
	3191.2570	3094.2516	2802.3960	2320.6530	1755.1122	1133.5752	721.6967	760.6152	1241.4288	1935.1792	2598.2706	3165.1837	(97)
Space heating kWh													
	1513.6926	1087.2920	759.9386	244.2180	36.6391	0.0000	0.0000	0.0000	0.0000	398.9828	1019.3217	1551.3088	(98a)
Space heating requirement - total per year (kWh/year)												6611.3936	
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													
	1513.6926	1087.2920	759.9386	244.2180	36.6391	0.0000	0.0000	0.0000	0.0000	398.9828	1019.3217	1551.3088	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6611.3936	
Space heating per m2											(98c) / (4) =	28.3386	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for June, July and August. See Table 10b													
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	1937.2156	1525.0421	1560.5871	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9752	0.9904	0.9795	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1889.1630	1510.4665	1528.6153	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2919.4866	2769.3317	2440.5127	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	741.8329	936.5958	678.4516	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.4715	(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	87.4428	110.4003	79.9718	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												277.8149	(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												0.0000	(203)
Fraction of total heating from main system 1												1.0000	(204)
Fraction of total heating from main system 2												0.0000	(205)
Efficiency of main space heating system 1 (in %)												100.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												5.1000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1513.6926	1087.2920	759.9386	244.2180	36.6391	0.0000	0.0000	0.0000	0.0000	398.9828	1019.3217	1551.3088	(98)
Space heating efficiency (main heating system 1)													
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)													
	1513.6926	1087.2920	759.9386	244.2180	36.6391	0.0000	0.0000	0.0000	0.0000	398.9828	1019.3217	1551.3088	(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)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement													
	317.5865	280.3955	296.2966	256.2570	245.6150	218.2390	212.9469	222.9955	227.2430	257.1210	278.0205	313.5214	(64)
Efficiency of water heater												334.9368	(216)
(217)m	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	(217)
Fuel for water heating, kWh/month													
	94.8198	83.7159	88.4634	76.5091	73.3317	65.1583	63.5782	66.5784	67.8465	76.7670	83.0068	93.6061	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	17.1456	21.6471	15.6807	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	89.5543	80.8878	89.5543	86.6655	89.5543	86.6655	89.5543	89.5543	86.6655	89.5543	86.6655	89.5543	(231)
Lighting	38.1080	30.5717	27.5264	20.1670	15.5776	12.7270	14.2104	18.4712	23.9923	31.4792	35.5556	39.1671	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-30.7047	-57.0049	-109.6572	-156.4200	-191.8904	-187.6541	-183.7542	-157.8152	-117.3420	-75.3973	-37.5297	-24.8373	(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												6611.3936	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												334.9368	
Water heating fuel used												933.3813	(219)
Space cooling fuel												54.4735	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2740)													
mechanical ventilation fans (SFP = 1.2740)												1013.4302	(230a)
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												1054.4302	(231)
Electricity for lighting (calculated in Appendix L)												307.5535	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1330.0069	(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												7631.2252	(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	6611.3936	0.1570	1037.7713	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	933.3813	0.1413	131.8480	(264)
Space and water heating			1169.6194	(265)
Space cooling	54.4735	0.1141	6.2166	(266)
Pumps, fans and electric keep-hot	1054.4302	0.1387	146.2625	(267)
Energy for lighting	307.5535	0.1443	44.3895	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1330.0069	0.1304	-173.4765	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-173.4765	(269)
Total CO2, kg/year			1193.0113	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.1100	(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	6611.3936	1.5811	10453.1840	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)

Water heating (other fuel)	933.3813	1.5223	1420.9243	(278)
Space and water heating			11874.1083	(279)
Space cooling	54.4735	1.4206	77.3862	(280)
Pumps, fans and electric keep-hot	1054.4302	1.5128	1595.1420	(281)
Energy for lighting	307.5535	1.5338	471.7358	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1330.0069	1.4818	-1970.8360	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1970.8360	(283)
Total Primary energy kWh/year			12047.5363	(286)
Dwelling Primary energy Rate (DPER)			51.6400	(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)	
Basement floor	67.3500	(1a) x	2.6900	(2a) =	181.1715	(1a) - (3a)
Ground floor	66.1500	(1b) x	2.7000	(2b) =	178.6050	(1b) - (3b)
First floor	53.5000	(1c) x	3.1000	(2c) =	165.8500	(1c) - (3c)
Second floor	46.3000	(1d) x	2.7300	(2d) =	126.3990	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	233.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		652.0255	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0613	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3113	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2880	(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	0.3672	0.3600	0.3528	0.3168	0.3096	0.2736	0.2736	0.2664	0.2880	0.3096	0.3240	0.3384	(22b)
Effective ac	0.5674	0.5648	0.5622	0.5502	0.5479	0.5374	0.5374	0.5355	0.5415	0.5479	0.5525	0.5573	(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 Semi-glazed door			3.4400	1.0000	3.4400			(26a)
TER Opening Type (Uw = 1.20)			49.5800	1.1450	56.7710			(27)
RLH01.HOR			1.2200	2.0221	2.4669			(27a)
RLH02.HOR			4.0900	2.0221	8.2702			(27a)
FT01.BASEMENT			67.3500	0.1300	8.7555			(28a)
FT05.EXPOSED			6.4100	0.1300	0.8333			(28b)
WT01.RETAINING	43.8700		43.8700	0.1800	7.8966			(29a)
WT05.RENDER	24.9200	7.5700	17.3500	0.1800	3.1230			(29a)
WT02.BRICK	126.0900	35.6900	90.4000	0.1800	16.2720			(29a)
WT0.MANSARD	43.6100	9.7600	33.8500	0.1800	6.0930			(29a)
RT01.FLAT ROOF	67.1400	5.3100	61.8300	0.1100	6.8013			(30)
RT02.FT06	3.9200		3.9200	0.1100	0.4312			(30)
RT01a.FR DORMER	0.8500		0.8500	0.1100	0.0935			(30)
Total net area of external elements Aum(A, m2)			384.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		121.2475			(33)
WT03.SOLID			34.1600	0.0000	0.0000			(32)
WT04.FULL FILL			90.9300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 261.0960 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	6.8000	0.0500	0.3400
E2 Other lintels (including other steel lintels)	15.9000	0.0500	0.7950
E3 Sill	7.9350	0.0500	0.3967
E4 Jamb	48.8000	0.0500	2.4400
E22 Basement floor	16.8000	0.0700	1.1760
E5 Ground floor (normal)	9.4500	0.1600	1.5120
E20 Exposed floor (normal)	7.0000	0.3200	2.2400

E21 Exposed floor (inverted)	3.8500	0.3200	1.2320	
E6 Intermediate floor within a dwelling	19.5000	0.0000	0.0000	
E14 Flat roof	5.7500	0.0800	0.4600	
E15 Flat roof with parapet	24.3000	0.5600	13.6080	
E16 Corner (normal)	2.4000	0.0900	0.2160	
E16 Corner (normal)	5.1000	0.0900	0.4590	
E16 Corner (normal)	17.4000	0.0900	1.5660	
E17 Corner (inverted - internal area greater than external area)	8.3000	-0.0900	-0.7470	
E18 Party wall between dwellings	11.8000	0.0600	0.7080	
P1 Party wall - Ground floor	12.6500	0.0800	1.0120	
P2 Party wall - Intermediate floor within a dwelling	31.8300	0.0000	0.0000	
P7 Party Wall - Exposed floor (normal)	0.9000	0.1600	0.1440	
P5 Party wall - Roof (insulation at rafter level)	12.7800	0.0800	1.0224	
E18 Party wall between dwellings	2.7000	0.0600	0.1620	
R11 Upstands or kerbs of rooflights	13.6000	0.0800	1.0880	
R7 Flat ceiling (inverted)	1.0000	0.0400	0.0400	
E24 Eaves (insulation at ceiling level - inverted)	19.9000	0.2400	4.7760	
E4 Jamb	12.4000	0.0500	0.6200	
E17 Corner (inverted - internal area greater than external area)	1.0000	-0.0900	-0.0900	
E16 Corner (normal)	15.9600	0.0900	1.4364	
E18 Party wall between dwellings	5.3200	0.0600	0.3192	
R9 Roof to wall (flat ceiling)	3.8500	0.0400	0.1540	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 37.0857 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 158.3333 (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	122.0900	121.5268	120.9746	118.3813	117.8961	115.6374	115.6374	115.2191	116.5074	117.8961	118.8777	119.9038	(38)
Heat transfer coeff	280.4233	279.8600	279.3079	276.7146	276.2294	273.9707	273.9707	273.5524	274.8407	276.2294	277.2109	278.2371	(39)
Average = Sum(39)m / 12 =												276.7123	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2020	1.1996	1.1972	1.1861	1.1840	1.1743	1.1743	1.1725	1.1781	1.1840	1.1882	1.1926	(40)
HLP (average)												1.1861	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0452 (42)
Hot water usage for mixer showers

75.2782	74.1469	72.4984	69.3443	67.0166	64.4209	62.9454	64.5814	66.3748	69.1619	72.3838	74.9898 (42a)

Hot water usage for baths

32.4953	32.0127	31.3331	30.0800	29.1418	28.1014	27.5394	28.2142	28.9490	30.0623	31.3412	32.3855 (42b)

Hot water usage for other uses

45.8161	44.1501	42.4840	40.8180	39.1519	37.4859	37.4859	39.1519	40.8180	42.4840	44.1501	45.8161 (42c)

Average daily hot water use (litres/day) 141.1833 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.5896	150.3097	146.3155	140.2423	135.3103	130.0081	127.9707	131.9476	136.1418	141.7082	147.8750	153.1913	(44)
Energy conte	243.2484	214.0390	224.8815	191.9847	182.1537	159.8601	154.7695	163.3787	167.8765	192.2967	210.6750	239.8606	(45)
Energy content (annual)										Total = Sum(45)m =		2345.0245	
Distribution loss (46)m = 0.15 x (45)m	36.4873	32.1058	33.7322	28.7977	27.3231	23.9790	23.2154	24.5068	25.1815	28.8445	31.6013	35.9791	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	289.8433	256.1247	271.4764	237.0766	228.7486	204.9520	201.3644	209.9736	212.9683	238.8916	255.7669	286.4555	(62)
WWHRS	-34.4141	-30.4361	-31.8709	-26.3904	-24.5949	-21.0460	-19.7273	-20.9780	-21.7750	-25.6703	-29.0814	-33.7768	(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	255.4292	225.6886	239.6055	210.6862	204.1538	183.9060	181.6371	188.9956	191.1933	213.2213	226.6855	252.6788	(64)
										Total per year (kWh/year) = Sum(64)m =		2573.8809	(64)
12Total per year (kWh/year)												2574	(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	118.1560	104.8365	112.0490	99.9084	97.8420	89.2270	88.7368	91.5993	91.8924	101.2146	106.1229	117.0296	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	202.6052	224.3129	202.6052	209.3587	202.6052	209.3587	202.6052	202.6052	209.3587	202.6052	209.3587	202.6052	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.6875	405.8558	395.3519	372.9904	344.7630	318.2332	300.5097	296.3414	306.8453	329.2068	357.4342	383.9640	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	(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)	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	(71)
Water heating gains (Table 5)	158.8118	156.0068	150.6035	138.7617	131.5081	123.9263	119.2698	123.1174	127.6283	136.0411	147.3929	157.2978	(72)
Total internal gains	834.7829	857.8537	820.2389	792.7890	750.5546	720.1966	691.0630	690.7423	712.5107	739.5314	785.8642	815.5453	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	26.9900	11.2829	0.6300	0.7000	0.7700	93.0673	(75)
Southeast	2.4300	36.7938	0.6300	0.7000	0.7700	27.3246	(77)
Southwest	15.1700	36.7938	0.6300	0.7000	0.7700	170.5817	(79)
Northwest	4.9900	11.2829	0.6300	0.7000	0.7700	17.2066	(81)
Northeast	5.3100	26.0000	0.6300	0.7000	1.0000	54.7960	(82)

Solar gains	362.9761	675.3803	1067.9847	1551.8029	1937.5515	2008.8000	1901.3969	1602.1976	1234.5849	785.9881	445.3479	303.6800	(83)
Total gains	1197.7590	1533.2341	1888.2237	2344.5919	2688.1061	2728.9966	2592.4599	2292.9399	1947.0956	1525.5195	1231.2121	1119.2253	(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	60.3390	60.4605	60.5800	61.1477	61.2551	61.7601	61.7601	61.8546	61.5646	61.2551	61.0382	60.8131	
alpha	5.0226	5.0307	5.0387	5.0765	5.0837	5.1173	5.1173	5.1236	5.1043	5.0837	5.0692	5.0542	
util living area	0.9992	0.9971	0.9885	0.9445	0.8161	0.6169	0.4600	0.5370	0.8250	0.9808	0.9979	0.9994	(86)
MIT	19.4665	19.6899	20.0387	20.4999	20.8345	20.9691	20.9943	20.9881	20.8718	20.3926	19.8427	19.4333	(87)
Th 2	19.9184	19.9203	19.9222	19.9311	19.9328	19.9406	19.9406	19.9420	19.9376	19.9328	19.9294	19.9259	(88)
util rest of house	0.9989	0.9960	0.9841	0.9239	0.7588	0.5257	0.3519	0.4196	0.7461	0.9704	0.9970	0.9992	(89)
MIT 2	18.1216	18.4090	18.8541	19.4295	19.8001	19.9244	19.9390	19.9382	19.8516	19.3113	18.6117	18.0844	(90)
Living area fraction										fLA = Living area / (4) =		0.1586	(91)
MIT	18.3349	18.6121	19.0420	19.5993	19.9641	20.0901	20.1063	20.1047	20.0134	19.4828	18.8069	18.2983	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3349	18.6121	19.0420	19.5993	19.9641	20.0901	20.1063	20.1047	20.0134	19.4828	18.8069	18.2983	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9940	0.9790	0.9160	0.7607	0.5391	0.3691	0.4382	0.7526	0.9642	0.9954	0.9987	(94)
Useful gains	1195.6398	1524.0846	1848.6043	2147.6006	2044.7713	1471.2409	956.8628	1004.7445	1465.3625	1470.9762	1225.5805	1117.8115	(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	3935.7082	3837.4752	3503.0714	2960.6458	2282.7959	1504.1195	960.6311	1013.4247	1625.2542	2453.6948	3245.2853	3922.6788	(97)
Space heating kWh	2038.6108	1554.5985	1230.9235	585.3925	177.0903	0.0000	0.0000	0.0000	0.0000	731.1426	1454.1875	2086.8213	(98a)
Space heating requirement - total per year (kWh/year)												9858.7671	
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	2038.6108	1554.5985	1230.9235	585.3925	177.0903	0.0000	0.0000	0.0000	0.0000	731.1426	1454.1875	2086.8213	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9858.7671	
Space heating per m2											(98c) / (4) =	42.2579	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	92.3000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2038.6108	1554.5985	1230.9235	585.3925	177.0903	0.0000	0.0000	0.0000	0.0000	731.1426	1454.1875	2086.8213	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	2208.6791	1684.2887	1333.6116	634.2281	191.8638	0.0000	0.0000	0.0000	0.0000	792.1372	1575.5011	2260.9114	(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	255.4292	225.6886	239.6055	210.6862	204.1538	183.9060	181.6371	188.9956	191.1933	213.2213	226.6855	252.6788	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6987	87.5483	87.1976	86.2263	83.7425	79.8000	79.8000	79.8000	79.8000	86.5949	87.4696	87.7313	(217)
Fuel for water heating, kWh/month	291.2577	257.7876	274.7845	244.3410	243.7876	230.4586	227.6154	236.8366	239.5906	246.2284	259.1592	288.0142	(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	42.0974	33.7721	30.4080	22.2782	17.2083	14.0594	15.6980	20.4049	26.5039	34.7746	39.2778	43.2674	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-63.4067	-89.6017	-129.0369	-145.2608	-156.6208	-145.9794	-143.9659	-135.7994	-121.5781	-102.3160	-69.7007	-54.7768	(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	-35.2069	-74.1292	-147.5285	-221.9334	-293.9066	-295.6569	-292.3872	-247.5420	-181.2669	-106.3799	-47.1082	-27.8535	(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	10681.2211	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	3039.8616	(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)	339.7498	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3328.9425	(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	10817.8901	(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	10681.2211	0.2100	2243.0564	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3039.8616	0.2100	638.3709	(264)
Space and water heating			2881.4274	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	339.7498	0.1443	49.0364	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1358.0432	0.1346	-182.7687	
PV Unit electricity exported	-1970.8993	0.1258	-248.0012	
Total			-430.7699	(269)
Total CO2, kg/year			2511.6231	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7700	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	10681.2211	1.1300	12069.7799	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3039.8616	1.1300	3435.0436	(278)
Space and water heating			15504.8235	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	339.7498	1.5338	521.1196	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1358.0432	1.4974	-2033.5255	
PV Unit electricity exported	-1970.8993	0.4619	-910.3261	
Total			-2943.8516	(283)
Total Primary energy kWh/year			13212.1923	(286)
Target Primary Energy Rate (TPER)			56.6300	(287)

Full SAP Calculation Printout

Property Reference	1Ja	**Issued on Date**	04/03/2024
Assessment Reference	1Ja	**Prop Type Ref**	1JA
Property	Unit 1Ja		

SAP Rating	75 C	**DER**	5.04	**TER**	10.66
Environmental	95 A	**% DER < TER**			52.72
CO_2 Emissions (t/year)	0.94	**DFEE**	45.83	**TFEE**	46.68
Compliance Check	See BREL	**% DFEE < TFEE**			1.82
% DPER < TPER	9.23	**DPER**	50.90	**TPER**	56.07

Assessor Details	Ms. Jemma McLaughlan	**Assessor ID**	W692-0001
Client	Gary Sugarman, Mr Gary Sugarman		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	67.3500	(1a)	x 2.6900	(2a) =	181.1715	(1a) - (3a)
Ground floor	66.1500	(1b)	x 2.7000	(2b) =	178.6050	(1b) - (3b)
First floor	53.5000	(1c)	x 3.1000	(2c) =	165.8500	(1c) - (3c)
Second floor	46.3000	(1d)	x 2.7300	(2d) =	126.3990	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	233.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		652.0255	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388 (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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

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

Effective ac	0.2584	0.2549	0.2515	0.2341	0.2307	0.2133	0.2133	0.2098	0.2202	0.2307	0.2376	0.2445	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			51.5300	1.0536	54.2941			(27)
Door			3.4400	1.1000	3.7840			(26a)
Windows 0.3 (Uw = 1.10)			7.1700	1.0536	7.5546			(27)
RLH01.HOR			1.4400	1.0536	1.5172			(27a)
RLH02.HOR			4.8400	1.0536	5.0996			(27a)
FT01.BASEMENT			67.3500	0.0900	6.0615	110.0000	7408.5000	(28a)
FT05.EXPOSED			6.4100	0.1300	0.8333	20.0000	128.2000	(28b)
WT01.RETAINING	43.8700		43.8700	0.1200	5.2644	140.0000	6141.8000	(29a)
WT05.RENDER	24.9200	8.9600	15.9600	0.1500	2.3940	140.0000	2234.4000	(29a)
WT02.BRICK	126.0900	41.6200	84.4700	0.1500	12.6705	140.0000	11825.8000	(29a)
WT0.MANSARD	43.6100	11.5600	32.0500	0.1500	4.8075	9.0000	288.4500	(29a)
RT01.FLAT ROOF	67.1400	6.2800	60.8600	0.0900	5.4774	9.0000	547.7400	(30)

RT02.FT06	3.9200	3.9200	0.0900	0.3528	9.0000	35.2800	(30)
RT01a.FR DORMER	0.8500	0.8500	0.1500	0.1275	9.0000	7.6500	(30)
Total net area of external elements Aum(A, m2)		384.1600					(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		110.2384			(33)
WT03.SOLID		34.1600	0.0000	0.0000	180.0000	6148.8000	(32)
WT04.FULL FILL		90.9300	0.0000	0.0000	110.0000	10002.3000	(32)
IWT1 - Stud		271.0000			9.0000	2439.0000	(32c)
IWT2 - Blockwork		125.3200			75.0000	9399.0000	(32c)
IFT1 - Timber		159.5100			18.0000	2871.1800	(32d)
ICT1 - Timber		159.5100			9.0000	1435.5900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	60913.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		261.0960 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.8000	0.0600	0.4080
E2 Other lintels (including other steel lintels)	15.9000	0.6000	9.5400
E3 Sill	7.9350	0.0040	0.0317
E4 Jamb	48.8000	0.0020	0.0976
E22 Basement floor	16.8000	0.2200	3.6960
E5 Ground floor (normal)	9.4500	0.3200	3.0240
E20 Exposed floor (normal)	7.0000	0.3200	2.2400
E21 Exposed floor (inverted)	3.8500	0.3200	1.2320
E6 Intermediate floor within a dwelling	19.5000	0.0010	0.0195
E14 Flat roof	5.7500	0.1600	0.9200
E15 Flat roof with parapet	24.3000	0.1050	2.5515
E16 Corner (normal)	2.4000	0.1800	0.4320
E16 Corner (normal)	5.1000	0.1800	0.9180
E16 Corner (normal)	17.4000	0.0410	0.7134
E17 Corner (inverted - internal area greater than external area)	8.3000	-0.0650	-0.5395
E18 Party wall between dwellings	11.8000	0.0350	0.4130
P1 Party wall - Ground floor	12.6500	0.3200	4.0480
P2 Party wall - Intermediate floor within a dwelling	31.8300	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	0.9000	0.4800	0.4320
P5 Party wall - Roof (insulation at rafter level)	12.7800	0.4800	6.1344
E18 Party wall between dwellings	2.7000	0.2400	0.6480
R11 Upstands or kerbs of rooflights	13.6000	0.2400	3.2640
R7 Flat ceiling (inverted)	1.0000	0.1200	0.1200
E24 Eaves (insulation at ceiling level - inverted)	19.9000	0.1500	2.9850
E4 Jamb	12.4000	0.1000	1.2400
E17 Corner (inverted - internal area greater than external area)	1.0000	0.0000	0.0000
E16 Corner (normal)	15.9600	0.1800	2.8728
E18 Party wall between dwellings	5.3200	0.2400	1.2768
R9 Roof to wall (flat ceiling)	3.8500	0.3200	1.2320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		49.9502 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	160.1887 (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	55.6009	54.8545	54.1081	50.3763	49.6299	45.8981	45.8981	45.1517	47.3908	49.6299	51.1227	52.6154	(38)
Heat transfer coeff	215.7895	215.0432	214.2968	210.5650	209.8186	206.0868	206.0868	205.3404	207.5795	209.8186	211.3113	212.8041	(39)
Average = Sum(39)m / 12 =												210.3784	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9249	0.9217	0.9185	0.9026	0.8994	0.8834	0.8834	0.8802	0.8898	0.8994	0.9057	0.9121	(40)
HLP (average)												0.9018	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy											3.0452	(42)
Hot water usage for mixer showers	103.5075	101.9520	99.6853	95.3484	92.1479	88.5787	86.5499	88.7995	91.2654	95.0976	99.5277	103.1109	(42a)
Hot water usage for baths	32.4953	32.0127	31.3331	30.0800	29.1418	28.1014	27.5394	28.2142	28.9490	30.0623	31.3412	32.3855	(42b)
Hot water usage for other uses	45.8161	44.1501	42.4840	40.8180	39.1519	37.4859	37.4859	39.1519	40.8180	42.4840	44.1501	45.8161	(42c)
Average daily hot water use (litres/day)												167.2097	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	181.8189	178.1148	173.5024	166.2464	160.4416	154.1659	151.5752	156.1656	161.0324	167.6439	175.0189	181.3125	(44)
Energy conte	287.9567	253.6331	266.6668	227.5830	215.9852	189.5650	183.3171	193.3657	198.5690	227.4912	249.3465	283.8916	(45)
Energy content (annual)										Total = Sum(45)m =		2777.3710	
Distribution loss (46)m = 0.15 x (45)m	43.1935	38.0450	40.0000	34.1375	32.3978	28.4347	27.4976	29.0049	29.7854	34.1237	37.4020	42.5837	(46)
Water storage loss:													
Store volume												269.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9558	(55)
Total storage loss	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(56)
If cylinder contains dedicated solar storage	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	317.5865	280.3955	296.2966	256.2570	245.6150	218.2390	212.9469	222.9955	227.2430	257.1210	278.0205	313.5214	(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	317.5865	280.3955	296.2966	256.2570	245.6150	218.2390	212.9469	222.9955	227.2430	257.1210	278.0205	313.5214	(64)
										Total per year (kWh/year) = Sum(64)m =		3126.2380	(64)
12Total per year (kWh/year)												3126	(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	95.7456	84.3330	88.6667	75.6714	71.8151	63.0304	60.9529	64.2941	66.0242	75.6408	82.9077	94.3939	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	202.6052	224.3129	202.6052	209.3587	202.6052	209.3587	202.6052	202.6052	209.3587	202.6052	209.3587	202.6052	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.6875	405.8558	395.3519	372.9904	344.7630	318.2332	300.5097	296.3414	306.8453	329.2068	357.4342	383.9640	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	(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)													
	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	(71)
Water heating gains (Table 5)													
	128.6903	125.4955	119.1757	105.0991	96.5256	87.5422	81.9260	86.4168	91.7003	101.6678	115.1496	126.8736	(72)
Total internal gains													
	804.6614	827.3425	788.8111	759.1265	715.5721	683.8124	653.7192	654.0417	676.5826	705.1581	753.6208	785.1211	(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	
Northeast	28.5100	11.2829	0.5700	0.7000	0.7700	88.9458	(75)
Southeast	5.9000	36.7938	0.5700	0.7000	0.7700	60.0251	(77)
Southwest	14.2400	36.7938	0.5700	0.7000	0.7700	144.8742	(79)
Northwest	2.8800	11.2829	0.5700	0.7000	0.7700	8.9851	(81)
Northeast	6.2800	26.0000	0.4500	0.7000	1.0000	46.2899	(82)
Northeast	3.4500	11.2829	0.3000	0.7000	0.7700	5.6649	(75)
Southwest	3.7200	36.7938	0.3000	0.7000	0.7700	19.9191	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	374.7042	689.9619	1074.8090	1540.2240	1907.7204	1972.1482	1868.9608	1584.2026	1235.0342	798.4481	458.3837	314.3873	(83)
Total gains	1179.3656	1517.3044	1863.6200	2299.3505	2623.2925	2655.9606	2522.6800	2238.2443	1911.6168	1503.6062	1212.0045	1099.5084	(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	78.4119	78.6841	78.9581	80.3575	80.6433	82.1036	82.1036	82.4020	81.5132	80.6433	80.0737	79.5120	
alpha	6.2275	6.2456	6.2639	6.3572	6.3762	6.4736	6.4736	6.4935	6.4342	6.3762	6.3382	6.3008	
util living area													
	0.9994	0.9967	0.9833	0.9042	0.7113	0.4939	0.3591	0.4211	0.7161	0.9691	0.9978	0.9996	(86)
MIT	20.1095	20.2740	20.5080	20.7879	20.9215	20.9495	20.9517	20.9514	20.9296	20.6988	20.3499	20.0903	(87)
Th 2	20.1463	20.1491	20.1518	20.1653	20.1681	20.1817	20.1817	20.1844	20.1762	20.1681	20.1626	20.1572	(88)
util rest of house													
	0.9991	0.9956	0.9776	0.8772	0.6580	0.4320	0.2925	0.3470	0.6436	0.9549	0.9969	0.9994	(89)
MIT 2	19.0854	19.2981	19.5966	19.9440	20.0829	20.1188	20.1200	20.1228	20.1004	19.8500	19.4069	19.0698	(90)
Living area fraction										fLA = Living area / (4) =		0.1586	(91)
MIT	19.2478	19.4529	19.7412	20.0778	20.2159	20.2505	20.2519	20.2542	20.2319	19.9846	19.5565	19.2317	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0978	19.3029	19.5912	19.9278	20.0659	20.1005	20.1019	20.1042	20.0819	19.8346	19.4065	19.0817	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9987	0.9940	0.9727	0.8683	0.6511	0.4258	0.2860	0.3396	0.6348	0.9474	0.9958	0.9992	(94)
Useful gains	1177.8593	1508.2744	1812.7500	1996.5010	1708.0660	1130.9578	721.5416	760.1657	1213.4748	1424.5748	1206.8624	1098.5935	(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													
	3193.2197	3097.2354	2805.3976	2322.0732	1755.3213	1133.5868	721.6978	760.6198	1241.7198	1937.5944	2600.4998	3166.8808	(97)
Space heating kWh													
	1499.4281	1067.7818	738.5298	234.4120	35.1580	0.0000	0.0000	0.0000	0.0000	381.6866	1003.4189	1538.8058	(98a)
Space heating requirement - total per year (kWh/year)												6499.2211	
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													
	1499.4281	1067.7818	738.5298	234.4120	35.1580	0.0000	0.0000	0.0000	0.0000	381.6866	1003.4189	1538.8058	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6499.2211	
Space heating per m2											(98c) / (4) =	27.8578	(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	1937.2156	1525.0421	1560.5871	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9760	0.9908	0.9808	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1890.7574	1511.0769	1530.5746	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2939.7545	2791.5932	2471.5149	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	755.2779	952.7041	700.0596	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.4715	(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	89.0276	112.2990	82.5188	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												283.8455	(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												0.0000	(203)
Fraction of total heating from main system 1												1.0000	(204)
Fraction of total heating from main system 2												0.0000	(205)
Efficiency of main space heating system 1 (in %)												100.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												5.1000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1499.4281	1067.7818	738.5298	234.4120	35.1580	0.0000	0.0000	0.0000	0.0000	381.6866	1003.4189	1538.8058	(98)
Space heating efficiency (main heating system 1)													
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)													
	1499.4281	1067.7818	738.5298	234.4120	35.1580	0.0000	0.0000	0.0000	0.0000	381.6866	1003.4189	1538.8058	(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)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement													
	317.5865	280.3955	296.2966	256.2570	245.6150	218.2390	212.9469	222.9955	227.2430	257.1210	278.0205	313.5214	(64)
Efficiency of water heater												334.9368	(216)
(217)m	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	334.9368	(217)
Fuel for water heating, kWh/month													
	94.8198	83.7159	88.4634	76.5091	73.3317	65.1583	63.5782	66.5784	67.8465	76.7670	83.0068	93.6061	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	17.4564	22.0194	16.1802	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	89.5543	80.8878	89.5543	86.6655	89.5543	86.6655	89.5543	89.5543	86.6655	89.5543	86.6655	89.5543	(231)
Lighting	38.1080	30.5717	27.5264	20.1670	15.5776	12.7270	14.2104	18.4712	23.9923	31.4792	35.5556	39.1671	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-30.7032	-56.9935	-109.5920	-156.2479	-191.8142	-187.6541	-183.7542	-157.8152	-117.3420	-75.3448	-37.5252	-24.8364	(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												6499.2211	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												334.9368	
Water heating fuel used												933.3813	(219)
Space cooling fuel												55.6560	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2740)													
mechanical ventilation fans (SFP = 1.2740)												1013.4302	(230a)
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												1054.4302	(231)
Electricity for lighting (calculated in Appendix L)												307.5535	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1329.6225	(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												7520.6195	(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	6499.2211	0.1570	1020.6597	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	933.3813	0.1413	131.8480	(264)
Space and water heating			1152.5077	(265)
Space cooling	55.6560	0.1141	6.3511	(266)
Pumps, fans and electric keep-hot	1054.4302	0.1387	146.2625	(267)
Energy for lighting	307.5535	0.1443	44.3895	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1329.6225	0.1304	-173.4218	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-173.4218	(269)
Total CO2, kg/year			1176.0889	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.0400	(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	6499.2211	1.5814	10277.6332	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)

Water heating (other fuel)	933.3813	1.5223	1420.9243	(278)
Space and water heating			11698.5574	(279)
Space cooling	55.6560	1.4206	79.0646	(280)
Pumps, fans and electric keep-hot	1054.4302	1.5128	1595.1420	(281)
Energy for lighting	307.5535	1.5338	471.7358	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1329.6225	1.4818	-1970.2490	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1970.2490	(283)
Total Primary energy kWh/year			11874.2508	(286)
Dwelling Primary energy Rate (DPER)			50.9000	(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)	
Basement floor	67.3500	(1a) x	2.6900	(2a) =	181.1715	(1a) - (3a)
Ground floor	66.1500	(1b) x	2.7000	(2b) =	178.6050	(1b) - (3b)
First floor	53.5000	(1c) x	3.1000	(2c) =	165.8500	(1c) - (3c)
Second floor	46.3000	(1d) x	2.7300	(2d) =	126.3990	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	233.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		652.0255	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0613	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3113	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2880	(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	0.3672	0.3600	0.3528	0.3168	0.3096	0.2736	0.2736	0.2664	0.2880	0.3096	0.3240	0.3384	(22b)
Effective ac	0.5674	0.5648	0.5622	0.5502	0.5479	0.5374	0.5374	0.5355	0.5415	0.5479	0.5525	0.5573	(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 Semi-glazed door			3.4400	1.0000	3.4400			(26a)
TER Opening Type (Uw = 1.20)			49.5800	1.1450	56.7710			(27)
RLH01.HOR			1.2200	2.0221	2.4669			(27a)
RLH02.HOR			4.0900	2.0221	8.2702			(27a)
FT01.BASEMENT			67.3500	0.1300	8.7555			(28a)
FT05.EXPOSED			6.4100	0.1300	0.8333			(28b)
WT01.RETAINING	43.8700		43.8700	0.1800	7.8966			(29a)
WT05.RENDER	24.9200	7.5700	17.3500	0.1800	3.1230			(29a)
WT02.BRICK	126.0900	35.6900	90.4000	0.1800	16.2720			(29a)
WT0.MANSARD	43.6100	9.7600	33.8500	0.1800	6.0930			(29a)
RT01.FLAT ROOF	67.1400	5.3100	61.8300	0.1100	6.8013			(30)
RT02.FT06	3.9200		3.9200	0.1100	0.4312			(30)
RT01a.FR DORMER	0.8500		0.8500	0.1100	0.0935			(30)
Total net area of external elements Aum(A, m2)			384.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		121.2475			(33)
WT03.SOLID			34.1600	0.0000	0.0000			(32)
WT04.FULL FILL			90.9300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 261.0960 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	6.8000	0.0500	0.3400
E2 Other lintels (including other steel lintels)	15.9000	0.0500	0.7950
E3 Sill	7.9350	0.0500	0.3967
E4 Jamb	48.8000	0.0500	2.4400
E22 Basement floor	16.8000	0.0700	1.1760
E5 Ground floor (normal)	9.4500	0.1600	1.5120
E20 Exposed floor (normal)	7.0000	0.3200	2.2400

E21 Exposed floor (inverted)	3.8500	0.3200	1.2320	
E6 Intermediate floor within a dwelling	19.5000	0.0000	0.0000	
E14 Flat roof	5.7500	0.0800	0.4600	
E15 Flat roof with parapet	24.3000	0.5600	13.6080	
E16 Corner (normal)	2.4000	0.0900	0.2160	
E16 Corner (normal)	5.1000	0.0900	0.4590	
E16 Corner (normal)	17.4000	0.0900	1.5660	
E17 Corner (inverted - internal area greater than external area)	8.3000	-0.0900	-0.7470	
E18 Party wall between dwellings	11.8000	0.0600	0.7080	
P1 Party wall - Ground floor	12.6500	0.0800	1.0120	
P2 Party wall - Intermediate floor within a dwelling	31.8300	0.0000	0.0000	
P7 Party Wall - Exposed floor (normal)	0.9000	0.1600	0.1440	
P5 Party wall - Roof (insulation at rafter level)	12.7800	0.0800	1.0224	
E18 Party wall between dwellings	2.7000	0.0600	0.1620	
R11 Upstands or kerbs of rooflights	13.6000	0.0800	1.0880	
R7 Flat ceiling (inverted)	1.0000	0.0400	0.0400	
E24 Eaves (insulation at ceiling level - inverted)	19.9000	0.2400	4.7760	
E4 Jamb	12.4000	0.0500	0.6200	
E17 Corner (inverted - internal area greater than external area)	1.0000	-0.0900	-0.0900	
E16 Corner (normal)	15.9600	0.0900	1.4364	
E18 Party wall between dwellings	5.3200	0.0600	0.3192	
R9 Roof to wall (flat ceiling)	3.8500	0.0400	0.1540	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 37.0857 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 158.3333 (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	122.0900	121.5268	120.9746	118.3813	117.8961	115.6374	115.6374	115.2191	116.5074	117.8961	118.8777	119.9038	(38)
Heat transfer coeff	280.4233	279.8600	279.3079	276.7146	276.2294	273.9707	273.9707	273.5524	274.8407	276.2294	277.2109	278.2371	(39)
Average = Sum(39)m / 12 =												276.7123	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2020	1.1996	1.1972	1.1861	1.1840	1.1743	1.1743	1.1725	1.1781	1.1840	1.1882	1.1926	(40)
HLP (average)												1.1861	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0452 (42)
Hot water usage for mixer showers

75.2782	74.1469	72.4984	69.3443	67.0166	64.4209	62.9454	64.5814	66.3748	69.1619	72.3838	74.9898 (42a)

Hot water usage for baths

32.4953	32.0127	31.3331	30.0800	29.1418	28.1014	27.5394	28.2142	28.9490	30.0623	31.3412	32.3855 (42b)

Hot water usage for other uses

45.8161	44.1501	42.4840	40.8180	39.1519	37.4859	37.4859	39.1519	40.8180	42.4840	44.1501	45.8161 (42c)

Average daily hot water use (litres/day) 141.1833 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.5896	150.3097	146.3155	140.2423	135.3103	130.0081	127.9707	131.9476	136.1418	141.7082	147.8750	153.1913	(44)
Energy conte	243.2484	214.0390	224.8815	191.9847	182.1537	159.8601	154.7695	163.3787	167.8765	192.2967	210.6750	239.8606	(45)
Energy content (annual)										Total = Sum(45)m =		2345.0245	
Distribution loss (46)m = 0.15 x (45)m	36.4873	32.1058	33.7322	28.7977	27.3231	23.9790	23.2154	24.5068	25.1815	28.8445	31.6013	35.9791	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	289.8433	256.1247	271.4764	237.0766	228.7486	204.9520	201.3644	209.9736	212.9683	238.8916	255.7669	286.4555	(62)
WWHRS	-34.4141	-30.4361	-31.8709	-26.3904	-24.5949	-21.0460	-19.7273	-20.9780	-21.7750	-25.6703	-29.0814	-33.7768	(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	255.4292	225.6886	239.6055	210.6862	204.1538	183.9060	181.6371	188.9956	191.1933	213.2213	226.6855	252.6788	(64)
										Total per year (kWh/year) = Sum(64)m =		2573.8809	(64)
12Total per year (kWh/year)												2574	(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	118.1560	104.8365	112.0490	99.9084	97.8420	89.2270	88.7368	91.5993	91.8924	101.2146	106.1229	117.0296	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	202.6052	224.3129	202.6052	209.3587	202.6052	209.3587	202.6052	202.6052	209.3587	202.6052	209.3587	202.6052	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.6875	405.8558	395.3519	372.9904	344.7630	318.2332	300.5097	296.3414	306.8453	329.2068	357.4342	383.9640	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	(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)	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	(71)
Water heating gains (Table 5)	158.8118	156.0068	150.6035	138.7617	131.5081	123.9263	119.2698	123.1174	127.6283	136.0411	147.3929	157.2978	(72)
Total internal gains	834.7829	857.8537	820.2389	792.7890	750.5546	720.1966	691.0630	690.7423	712.5107	739.5314	785.8642	815.5453	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	26.9900	11.2829	0.6300	0.7000	0.7700	93.0673	(75)
Southeast	4.9900	36.7938	0.6300	0.7000	0.7700	56.1109	(77)
Southwest	15.1700	36.7938	0.6300	0.7000	0.7700	170.5817	(79)
Northwest	2.4300	11.2829	0.6300	0.7000	0.7700	8.3792	(81)
Northeast	5.3100	26.0000	0.6300	0.7000	1.0000	54.7960	(82)

Solar gains	382.9351	706.4457	1102.7015	1581.7643	1959.1955	2025.0464	1919.2413	1627.0484	1267.7819	818.2220	468.7202	321.1062	(83)
Total gains	1217.7179	1564.2994	1922.9404	2374.5534	2709.7501	2745.2429	2610.3043	2317.7907	1980.2925	1557.7534	1254.5844	1136.6515	(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	60.3390	60.4605	60.5800	61.1477	61.2551	61.7601	61.7601	61.8546	61.5646	61.2551	61.0382	60.8131	
alpha	5.0226	5.0307	5.0387	5.0765	5.0837	5.1173	5.1173	5.1236	5.1043	5.0837	5.0692	5.0542	
util living area	0.9991	0.9968	0.9875	0.9420	0.8125	0.6138	0.4570	0.5318	0.8176	0.9791	0.9977	0.9994	(86)
MIT	19.4752	19.7034	20.0530	20.5097	20.8380	20.9698	20.9944	20.9886	20.8775	20.4054	19.8529	19.4410	(87)
Th 2	19.9184	19.9203	19.9222	19.9311	19.9328	19.9406	19.9406	19.9420	19.9376	19.9328	19.9294	19.9259	(88)
util rest of house	0.9988	0.9956	0.9828	0.9207	0.7548	0.5228	0.3496	0.4152	0.7376	0.9679	0.9967	0.9992	(89)
MIT 2	18.1328	18.4261	18.8721	19.4408	19.8033	19.9248	19.9390	19.9384	19.8561	19.3268	18.6247	18.0942	(90)
Living area fraction										fLA = Living area / (4) =		0.1586	(91)
MIT	18.3457	18.6287	19.0594	19.6104	19.9674	20.0905	20.1064	20.1049	20.0181	19.4979	18.8195	18.3078	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3457	18.6287	19.0594	19.6104	19.9674	20.0905	20.1064	20.1049	20.0181	19.4979	18.8195	18.3078	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9935	0.9776	0.9128	0.7569	0.5362	0.3666	0.4337	0.7445	0.9616	0.9950	0.9986	(94)
Useful gains	1215.4021	1554.1610	1879.7795	2167.4636	2051.0246	1472.1301	956.9969	1005.2056	1474.3372	1497.8646	1248.3727	1135.1135	(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	3938.7382	3842.1085	3507.9260	2963.7136	2283.6952	1504.2391	960.6500	1013.4884	1626.5296	2457.8598	3248.7634	3925.3127	(97)
Space heating kWh	2026.1621	1537.5007	1211.3410	573.3000	173.1069	0.0000	0.0000	0.0000	0.0000	714.2365	1440.2813	2075.9082	(98a)
Space heating requirement - total per year (kWh/year)												9751.8366	
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	2026.1621	1537.5007	1211.3410	573.3000	173.1069	0.0000	0.0000	0.0000	0.0000	714.2365	1440.2813	2075.9082	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9751.8366	
Space heating per m2											(98c) / (4) =	41.7996	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2026.1621	1537.5007	1211.3410	573.3000	173.1069	0.0000	0.0000	0.0000	0.0000	714.2365	1440.2813	2075.9082	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	2195.1918	1665.7645	1312.3955	621.1268	187.5481	0.0000	0.0000	0.0000	0.0000	773.8207	1560.4347	2249.0880	(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	255.4292	225.6886	239.6055	210.6862	204.1538	183.9060	181.6371	188.9956	191.1933	213.2213	226.6855	252.6788	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6928	87.5363	87.1764	86.1878	83.6921	79.8000	79.8000	79.8000	79.8000	86.5557	87.4587	87.7264	(217)
Fuel for water heating, kWh/month	291.2774	257.8229	274.8514	244.4502	243.9342	230.4586	227.6154	236.8366	239.5906	246.3398	259.1916	288.0305	(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	42.0974	33.7721	30.4080	22.2782	17.2083	14.0594	15.6980	20.4049	26.5039	34.7746	39.2778	43.2674	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-63.4067	-89.6017	-129.0369	-145.2608	-156.6208	-145.9794	-143.9659	-135.7994	-121.5781	-102.3160	-69.7007	-54.7768	(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	-35.2069	-74.1292	-147.5285	-221.9334	-293.9066	-295.6569	-292.3872	-247.5420	-181.2669	-106.3799	-47.1082	-27.8535	(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	10565.3701	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	3040.3994	(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)	339.7498	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3328.9425	(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	10702.5768	(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	10565.3701	0.2100	2218.7277	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3040.3994	0.2100	638.4839	(264)
Space and water heating			2857.2116	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	339.7498	0.1443	49.0364	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1358.0432	0.1346	-182.7687	
PV Unit electricity exported	-1970.8993	0.1258	-248.0012	
Total			-430.7699	(269)
Total CO2, kg/year			2487.4074	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.6600	(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	10565.3701	1.1300	11938.8682	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3040.3994	1.1300	3435.6513	(278)
Space and water heating			15374.5195	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	339.7498	1.5338	521.1196	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1358.0432	1.4974	-2033.5255	
PV Unit electricity exported	-1970.8993	0.4619	-910.3261	
Total			-2943.8516	(283)
Total Primary energy kWh/year			13081.8883	(286)
Target Primary Energy Rate (TPER)			56.0700	(287)

APPENDIX C: SAP Calculation Worksheets BE LEAN

Full SAP Calculation Printout

Property Reference	1Ha	**Issued on Date**	04/03/2024
Assessment Reference	1Ha - BE LEAN	**Prop Type Ref**	1h - Left (nw)
Property	Unit 1H		

SAP Rating	84 B	**DER**	11.87	**TER**	10.85
Environmental	87 B	**% DER < TER**			-9.40
CO_2 Emissions (t/year)	2.4	**DFEE**	46.31	**TFEE**	47.13
Compliance Check	See BREL	**% DFEE < TFEE**			1.74
% DPER < TPER	-20.40	**DPER**	68.73	**TPER**	57.08

Assessor Details	Ms. Jemma McLaughlan	**Assessor ID**	W692-0001
Client	Gary Sugarman, Mr Gary Sugarman		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	67.3500 (1a)	x	2.6900 (2a)	=	181.1715	(1a) - (3a)
Ground floor	66.1500 (1b)	x	2.7000 (2b)	=	178.6050	(1b) - (3b)
First floor	53.5000 (1c)	x	3.1000 (2c)	=	165.8500	(1c) - (3c)
Second floor	46.3000 (1d)	x	2.7300 (2d)	=	126.3990	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	233.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	652.0255	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

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

Effective ac	0.2584	0.2549	0.2515	0.2341	0.2307	0.2133	0.2133	0.2098	0.2202	0.2307	0.2376	0.2445	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			51.5300	1.0536	54.2941			(27)
Door			3.4400	1.1000	3.7840			(26a)
window 0.3 (Uw = 1.10)			7.1700	1.0536	7.5546			(27)
RLH01.HOR			1.4400	1.0536	1.5172			(27a)
RLH02.HOR			4.8400	1.0536	5.0996			(27a)
FT01.BASEMENT			67.3500	0.0900	6.0615	110.0000	7408.5000	(28a)
FT05.EXPOSED			6.4100	0.1300	0.8333	20.0000	128.2000	(28b)
WT01.RETAINING	43.8700		43.8700	0.1200	5.2644	140.0000	6141.8000	(29a)
WT05.RENDER	24.9200	8.9600	15.9600	0.1500	2.3940	140.0000	2234.4000	(29a)
WT02.BRICK	126.0900	41.6200	84.4700	0.1500	12.6705	140.0000	11825.8000	(29a)
WT0.MANSARD	43.6100	11.5600	32.0500	0.1500	4.8075	9.0000	288.4500	(29a)
RT01.FLAT ROOF	67.1400	6.2800	60.8600	0.0900	5.4774	9.0000	547.7400	(30)

RT02.FT06	3.9200	3.9200	0.0900	0.3528	9.0000	35.2800	(30)
RT01a.FR DORMER	0.8500	0.8500	0.1500	0.1275	9.0000	7.6500	(30)
Total net area of external elements Aum(A, m2)		384.1600					(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		110.2384			(33)
WT03.SOLID		34.1600	0.0000	0.0000	180.0000	6148.8000	(32)
WT04.FULL FILL		90.9300	0.0000	0.0000	110.0000	10002.3000	(32)
IWT1 - Stud		271.0000			9.0000	2439.0000	(32c)
IWT2 - Blockwork		125.3200			75.0000	9399.0000	(32c)
IFT1 - Timber		159.5100			18.0000	2871.1800	(32d)
ICT1 - Timber		159.5100			9.0000	1435.5900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	60913.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		261.0960 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	6.8000	0.0600	0.4080
E2 Other lintels (including other steel lintels)	15.9000	0.6000	9.5400
E3 Sill	7.9350	0.0040	0.0317
E4 Jamb	48.8000	0.0020	0.0976
E22 Basement floor	16.8000	0.2200	3.6960
E5 Ground floor (normal)	9.4500	0.3200	3.0240
E20 Exposed floor (normal)	7.0000	0.3200	2.2400
E21 Exposed floor (inverted)	3.8500	0.3200	1.2320
E6 Intermediate floor within a dwelling	19.5000	0.0010	0.0195
E14 Flat roof	5.7500	0.1600	0.9200
E15 Flat roof with parapet	24.3000	0.1050	2.5515
E16 Corner (normal)	2.4000	0.1800	0.4320
E16 Corner (normal)	5.1000	0.1800	0.9180
E16 Corner (normal)	17.4000	0.0410	0.7134
E17 Corner (inverted - internal area greater than external area)	8.3000	-0.0650	-0.5395
E18 Party wall between dwellings	11.8000	0.0350	0.4130
P1 Party wall - Ground floor	12.6500	0.3200	4.0480
P2 Party wall - Intermediate floor within a dwelling	31.8300	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	0.9000	0.4800	0.4320
P5 Party wall - Roof (insulation at rafter level)	12.7800	0.4800	6.1344
E18 Party wall between dwellings	2.7000	0.2400	0.6480
R11 Upstands or kerbs of rooflights	13.6000	0.2400	3.2640
R7 Flat ceiling (inverted)	1.0000	0.1200	0.1200
E24 Eaves (insulation at ceiling level - inverted)	19.9000	0.1500	2.9850
E4 Jamb	12.4000	0.1000	1.2400
E17 Corner (inverted - internal area greater than external area)	1.0000	0.0000	0.0000
E16 Corner (normal)	15.9600	0.1800	2.8728
E18 Party wall between dwellings	5.3200	0.2400	1.2768
R9 Roof to wall (flat ceiling)	3.8500	0.3200	1.2320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		49.9502 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	160.1887 (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	55.6009	54.8545	54.1081	50.3763	49.6299	45.8981	45.8981	45.1517	47.3908	49.6299	51.1227	52.6154	(38)
Heat transfer coeff	215.7895	215.0432	214.2968	210.5650	209.8186	206.0868	206.0868	205.3404	207.5795	209.8186	211.3113	212.8041	(39)
Average = Sum(39)m / 12 =												210.3784	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9249	0.9217	0.9185	0.9026	0.8994	0.8834	0.8834	0.8802	0.8898	0.8994	0.9057	0.9121	(40)
HLP (average)												0.9018	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0452	(42)
Hot water usage for mixer showers	103.5075	101.9520	99.6853	95.3484	92.1479	88.5787	86.5499	88.7995	91.2654	95.0976	99.5277	103.1109	(42a)
Hot water usage for baths	32.4953	32.0127	31.3331	30.0800	29.1418	28.1014	27.5394	28.2142	28.9490	30.0623	31.3412	32.3855	(42b)
Hot water usage for other uses	45.8161	44.1501	42.4840	40.8180	39.1519	37.4859	37.4859	39.1519	40.8180	42.4840	44.1501	45.8161	(42c)
Average daily hot water use (litres/day)												167.2097	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	181.8189	178.1148	173.5024	166.2464	160.4416	154.1659	151.5752	156.1656	161.0324	167.6439	175.0189	181.3125	(44)
Energy conte	287.9567	253.6331	266.6668	227.5830	215.9852	189.5650	183.3171	193.3657	198.5690	227.4912	249.3465	283.8916	(45)
Energy content (annual)										Total = Sum(45)m =		2777.3710	
Distribution loss (46)m = 0.15 x (45)m	43.1935	38.0450	40.0000	34.1375	32.3978	28.4347	27.4976	29.0049	29.7854	34.1237	37.4020	42.5837	(46)
Water storage loss:													
Store volume												269.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9558	(55)
Total storage loss	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(56)
If cylinder contains dedicated solar storage	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	340.8489	301.4067	319.5590	278.7690	268.8774	240.7510	236.2093	246.2579	249.7550	280.3834	300.5325	336.7838	(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	340.8489	301.4067	319.5590	278.7690	268.8774	240.7510	236.2093	246.2579	249.7550	280.3834	300.5325	336.7838	(64)
										Total per year (kWh/year) = Sum(64)m =		3400.1340	(64)
12Total per year (kWh/year)												3400	(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	138.0594	122.5519	130.9805	116.6202	114.1288	103.9792	103.2667	106.6079	106.9730	117.9546	123.8565	136.7077	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	202.6052	224.3129	202.6052	209.3587	202.6052	209.3587	202.6052	202.6052	209.3587	202.6052	209.3587	202.6052	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.6875	405.8558	395.3519	372.9904	344.7630	318.2332	300.5097	296.3414	306.8453	329.2068	357.4342	383.9640	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	(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)													
	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	(71)
Water heating gains (Table 5)													
	185.5637	182.3689	176.0490	161.9724	153.3990	144.4155	138.7993	143.2901	148.5736	158.5411	172.0229	183.7469	(72)
Total internal gains													
	861.5347	884.2158	845.6844	815.9998	772.4455	740.6857	710.5925	710.9151	733.4559	762.0314	810.4942	841.9944	(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	
Northeast	28.5100	11.2829	0.5700	0.7000	0.7700	88.9458	(75)
Southeast	2.8800	36.7938	0.5700	0.7000	0.7700	29.3004	(77)
Southwest	14.2400	36.7938	0.5700	0.7000	0.7700	144.8742	(79)
Northwest	5.9000	11.2829	0.5700	0.7000	0.7700	18.4069	(81)
Northeast	6.2800	26.0000	0.4500	0.7000	1.0000	46.2899	(82)
Northeast	3.4500	11.2829	0.3000	0.7000	0.7700	5.6649	(75)
Southwest	3.7200	36.7938	0.3000	0.7000	0.7700	19.9191	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	353.4013	656.8048	1037.7545	1508.2451	1884.6189	1954.8078	1849.9149	1557.6784	1199.6019	764.0436	433.4376	295.7877	(83)
Total gains	1214.9360	1541.0206	1883.4389	2324.2449	2657.0644	2695.4936	2560.5074	2268.5935	1933.0579	1526.0751	1243.9318	1137.7821	(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	78.4119	78.6841	78.9581	80.3575	80.6433	82.1036	82.1036	82.4020	81.5132	80.6433	80.0737	79.5120	
alpha	6.2275	6.2456	6.2639	6.3572	6.3762	6.4736	6.4736	6.4935	6.4342	6.3762	6.3382	6.3008	
util living area													
	0.9992	0.9965	0.9824	0.9004	0.7040	0.4869	0.3539	0.4155	0.7097	0.9669	0.9975	0.9995	(86)
MIT	19.8955	20.1090	20.4183	20.7887	20.9625	20.9969	20.9997	20.9991	20.9719	20.6719	20.2131	19.8705	(87)
Th 2	20.1463	20.1491	20.1518	20.1653	20.1681	20.1817	20.1817	20.1844	20.1762	20.1681	20.1626	20.1572	(88)
util rest of house													
	0.9990	0.9952	0.9765	0.8727	0.6507	0.4258	0.2882	0.3423	0.6373	0.9519	0.9965	0.9993	(89)
MIT 2	19.1268	19.3418	19.6490	20.0058	20.1459	20.1804	20.1816	20.1842	20.1626	19.9104	19.4572	19.1107	(90)
Living area fraction										fLA = Living area / (4) =		0.1586	(91)
MIT	19.2487	19.4635	19.7710	20.1300	20.2754	20.3099	20.3113	20.3134	20.2909	20.0311	19.5771	19.2312	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2487	19.4635	19.7710	20.1300	20.2754	20.3099	20.3113	20.3134	20.2909	20.0311	19.5771	19.2312	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9939	0.9731	0.8714	0.6579	0.4354	0.2986	0.3540	0.6479	0.9488	0.9955	0.9990	(94)
Useful gains	1213.2033	1531.6310	1832.7606	2025.3641	1748.0239	1173.6329	764.6421	802.9689	1252.3898	1447.9649	1238.2882	1136.6936	(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													
	3225.7761	3131.7709	2843.9382	2364.6436	1799.2828	1176.7388	764.8571	803.5834	1285.1100	1978.8280	2636.5565	3198.7045	(97)
Space heating kWh													
	1497.3542	1075.2940	752.3161	244.2812	38.1366	0.0000	0.0000	0.0000	0.0000	394.9621	1006.7532	1534.1362	(98a)
Space heating requirement - total per year (kWh/year)												6543.2337	
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													
	1497.3542	1075.2940	752.3161	244.2812	38.1366	0.0000	0.0000	0.0000	0.0000	394.9621	1006.7532	1534.1362	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6543.2337	
Space heating per m2											(98c) / (4) =	28.0464	(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	1937.2156	1525.0421	1560.5871	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9774	0.9914	0.9818	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1893.4939	1511.9702	1532.1095	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2976.3599	2826.2051	2497.3860	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	779.6635	977.7908	718.1657	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.4715	(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	91.9020	115.2561	84.6531	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												291.8112	(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)
Efficiency of main space heating system 1 (in %)												83.0800	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												5.1000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1497.3542	1075.2940	752.3161	244.2812	38.1366	0.0000	0.0000	0.0000	0.0000	394.9621	1006.7532	1534.1362	(98)
Space heating efficiency (main heating system 1)													
	83.0800	83.0800	83.0800	83.0800	83.0800	0.0000	0.0000	0.0000	0.0000	83.0800	83.0800	83.0800	(210)
Space heating fuel (main heating system)													
	1802.3040	1294.2875	905.5322	294.0313	45.9035	0.0000	0.0000	0.0000	0.0000	475.3998	1211.7877	1846.5770	(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													
	340.8489	301.4067	319.5590	278.7690	268.8774	240.7510	236.2093	246.2579	249.7550	280.3834	300.5325	336.7838	(64)
Efficiency of water heater												79.8000	(216)
(217)m	81.4174	81.1236	80.4371	78.4644	75.7428	74.8000	74.8000	74.8000	74.8000	79.4424	81.0279	81.4650	(217)
Fuel for water heating, kWh/month													
	418.6440	371.5402	397.2781	355.2810	354.9872	321.8596	315.7878	329.2218	333.8971	352.9393	370.8998	413.4090	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	18.0200	22.5992	16.5986	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	94.4209	85.2834	94.4209	91.3751	94.4209	91.3751	94.4209	94.4209	91.3751	94.4209	91.3751	94.4209	(231)
Lighting	38.1080	30.5717	27.5264	20.1670	15.5776	12.7270	14.2104	18.4712	23.9923	31.4792	35.5556	39.1671	(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	7875.8229	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	4335.7449	(219)
Space cooling fuel	57.2179	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2740)		
mechanical ventilation fans (SFP = 1.2740)	1013.4302	(230a)
central heating pump	53.3000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	1111.7302	(231)
Electricity for lighting (calculated in Appendix L)	307.5535	(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	13688.0694	(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	7875.8229	0.2100	1653.9228	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4335.7449	0.2100	910.5064	(264)
Space and water heating			2564.4292	(265)
Space cooling	57.2179	0.1141	6.5300	(266)
Pumps, fans and electric keep-hot	1111.7302	0.1387	154.2107	(267)
Energy for lighting	307.5535	0.1443	44.3895	(268)
Total CO2, kg/year			2769.5594	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.8700	(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	7875.8229	1.1300	8899.6799	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4335.7449	1.1300	4899.3917	(278)
Space and water heating			13799.0717	(279)
Space cooling	57.2179	1.4206	81.2856	(280)
Pumps, fans and electric keep-hot	1111.7302	1.5128	1681.8254	(281)
Energy for lighting	307.5535	1.5338	471.7358	(282)
Total Primary energy kWh/year			16033.9185	(286)
Dwelling Primary energy Rate (DPER)			68.7300	(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)	
Basement floor	67.3500	(1a) x	2.6900	(2a) =	181.1715	(1a) - (3a)
Ground floor	66.1500	(1b) x	2.7000	(2b) =	178.6050	(1b) - (3b)
First floor	53.5000	(1c) x	3.1000	(2c) =	165.8500	(1c) - (3c)
Second floor	46.3000	(1d) x	2.7300	(2d) =	126.3990	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	233.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		652.0255	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0613	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3113	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2880	(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	0.3672	0.3600	0.3528	0.3168	0.3096	0.2736	0.2736	0.2664	0.2880	0.3096	0.3240	0.3384	(22b)
Effective ac	0.5674	0.5648	0.5622	0.5502	0.5479	0.5374	0.5374	0.5355	0.5415	0.5479	0.5525	0.5573	(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 Semi-glazed door			3.4400	1.0000	3.4400			(26a)
TER Opening Type (Uw = 1.20)			49.5800	1.1450	56.7710			(27)
RLH01.HOR			1.2200	2.0221	2.4669			(27a)
RLH02.HOR			4.0900	2.0221	8.2702			(27a)
FT01.BASEMENT			67.3500	0.1300	8.7555			(28a)
FT05.EXPOSED			6.4100	0.1300	0.8333			(28b)
WT01.RETAINING	43.8700		43.8700	0.1800	7.8966			(29a)
WT05.RENDER	24.9200	7.5700	17.3500	0.1800	3.1230			(29a)
WT02.BRICK	126.0900	35.6900	90.4000	0.1800	16.2720			(29a)
WT0.MANSARD	43.6100	9.7600	33.8500	0.1800	6.0930			(29a)
RT01.FLAT ROOF	67.1400	5.3100	61.8300	0.1100	6.8013			(30)
RT02.FT06	3.9200		3.9200	0.1100	0.4312			(30)
RT01a.FR DORMER	0.8500		0.8500	0.1100	0.0935			(30)
Total net area of external elements Aum(A, m2)			384.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		121.2475			(33)
WT03.SOLID			34.1600	0.0000	0.0000			(32)
WT04.FULL FILL			90.9300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 261.0960 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.8000	0.0500	0.3400
E2 Other lintels (including other steel lintels)	15.9000	0.0500	0.7950
E3 Sill	7.9350	0.0500	0.3967
E4 Jamb	48.8000	0.0500	2.4400
E22 Basement floor	16.8000	0.0700	1.1760
E5 Ground floor (normal)	9.4500	0.1600	1.5120
E20 Exposed floor (normal)	7.0000	0.3200	2.2400
E21 Exposed floor (inverted)	3.8500	0.3200	1.2320
E6 Intermediate floor within a dwelling	19.5000	0.0000	0.0000
E14 Flat roof	5.7500	0.0800	0.4600
E15 Flat roof with parapet	24.3000	0.5600	13.6080
E16 Corner (normal)	2.4000	0.0900	0.2160
E16 Corner (normal)	5.1000	0.0900	0.4590
E16 Corner (normal)	17.4000	0.0900	1.5660
E17 Corner (inverted - internal area greater than external area)	8.3000	-0.0900	-0.7470
E18 Party wall between dwellings	11.8000	0.0600	0.7080
P1 Party wall - Ground floor	12.6500	0.0800	1.0120
P2 Party wall - Intermediate floor within a dwelling	31.8300	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	0.9000	0.1600	0.1440
P5 Party wall - Roof (insulation at rafter level)	12.7800	0.0800	1.0224
E18 Party wall between dwellings	2.7000	0.0600	0.1620
R11 Upstands or kerbs of rooflights	13.6000	0.0800	1.0880

R7 Flat ceiling (inverted)	1.0000	0.0400	0.0400	
E24 Eaves (insulation at ceiling level - inverted)	19.9000	0.2400	4.7760	
E4 Jamb	12.4000	0.0500	0.6200	
E17 Corner (inverted - internal area greater than external area)	1.0000	-0.0900	-0.0900	
E16 Corner (normal)	15.9600	0.0900	1.4364	
E18 Party wall between dwellings	5.3200	0.0600	0.3192	
R9 Roof to wall (flat ceiling)	3.8500	0.0400	0.1540	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 37.0857 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 158.3333 (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	122.0900	121.5268	120.9746	118.3813	117.8961	115.6374	115.6374	115.2191	116.5074	117.8961	118.8777	119.9038	(38)
Heat transfer coeff	280.4233	279.8600	279.3079	276.7146	276.2294	273.9707	273.9707	273.5524	274.8407	276.2294	277.2109	278.2371	(39)
Average = Sum(39)m / 12 =												276.7123	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2020	1.1996	1.1972	1.1861	1.1840	1.1743	1.1743	1.1725	1.1781	1.1840	1.1882	1.1926	(40)
HLP (average)												1.1861	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0452 (42)
Hot water usage for mixer showers

75.2782	74.1469	72.4984	69.3443	67.0166	64.4209	62.9454	64.5814	66.3748	69.1619	72.3838	74.9898	(42a)

Hot water usage for baths

32.4953	32.0127	31.3331	30.0800	29.1418	28.1014	27.5394	28.2142	28.9490	30.0623	31.3412	32.3855	(42b)

Hot water usage for other uses

45.8161	44.1501	42.4840	40.8180	39.1519	37.4859	37.4859	39.1519	40.8180	42.4840	44.1501	45.8161	(42c)

Average daily hot water use (litres/day) 141.1833 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.5896	150.3097	146.3155	140.2423	135.3103	130.0081	127.9707	131.9476	136.1418	141.7082	147.8750	153.1913	(44)
Energy conte	243.2484	214.0390	224.8815	191.9847	182.1537	159.8601	154.7695	163.3787	167.8765	192.2967	210.6750	239.8606	(45)
Energy content (annual)										Total = Sum(45)m =		2345.0245	
Distribution loss (46)m = 0.15 x (45)m	36.4873	32.1058	33.7322	28.7977	27.3231	23.9790	23.2154	24.5068	25.1815	28.8445	31.6013	35.9791	(46)
Water storage loss:													
Store volume												269.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9764	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0673	(55)
Total storage loss	33.0856	29.8838	33.0856	32.0184	33.0856	32.0184	33.0856	33.0856	32.0184	33.0856	32.0184	33.0856	(56)
If cylinder contains dedicated solar storage	33.0856	29.8838	33.0856	32.0184	33.0856	32.0184	33.0856	33.0856	32.0184	33.0856	32.0184	33.0856	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	299.5964	264.9340	281.2296	246.5151	238.5018	214.3905	211.1175	219.7267	222.4068	248.6447	265.2054	296.2086	(62)
WWHRS	-34.4141	-30.4361	-31.8709	-26.3904	-24.5949	-21.0460	-19.7273	-20.9780	-21.7750	-25.6703	-29.0814	-33.7768	(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	265.1824	234.4979	249.3587	220.1247	213.9069	193.3445	191.3902	198.7488	200.6318	222.9744	236.1240	262.4319	(64)
										Total per year (kWh/year) = Sum(64)m =		2688.7162	(64)
12Total per year (kWh/year)												2689	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	125.9585	111.8840	119.8515	107.4592	105.6445	96.7778	96.5393	99.4018	99.4432	109.0171	113.6737	124.8321	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	202.6052	224.3129	202.6052	209.3587	202.6052	209.3587	202.6052	202.6052	209.3587	202.6052	209.3587	202.6052	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.6875	405.8558	395.3519	372.9904	344.7630	318.2332	300.5097	296.3414	306.8453	329.2068	357.4342	383.9640	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	(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)	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	(71)
Water heating gains (Table 5)	169.2991	166.4940	161.0908	149.2489	141.9953	134.4136	129.7571	133.6046	138.1156	146.5283	157.8802	167.7851	(72)
Total internal gains	845.2701	868.3410	830.7262	803.2763	761.0418	730.6838	701.5503	701.2296	722.9979	750.0187	796.3514	826.0325	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	26.9900	11.2829	0.6300	0.7000	0.7700	93.0673	(75)
Southeast	2.4300	36.7938	0.6300	0.7000	0.7700	27.3246	(77)
Southwest	15.1700	36.7938	0.6300	0.7000	0.7700	170.5817	(79)
Northwest	4.9900	11.2829	0.6300	0.7000	0.7700	17.2066	(81)
Northeast	5.3100	26.0000	0.6300	0.7000	1.0000	54.7960	(82)

Solar gains	362.9761	675.3803	1067.9847	1551.8029	1937.5515	2008.8000	1901.3969	1602.1976	1234.5849	785.9881	445.3479	303.6800	(83)

Total gains	1208.2462	1543.7213	1898.7109	2355.0792	2698.5933	2739.4838	2602.9472	2303.4271	1957.5828	1536.0067	1241.6993	1129.7126	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.3390	60.4605	60.5800	61.1477	61.2551	61.7601	61.7601	61.8546	61.5646	61.2551	61.0382	60.8131	
alpha	5.0226	5.0307	5.0387	5.0765	5.0837	5.1173	5.1173	5.1236	5.1043	5.0837	5.0692	5.0542	
util living area													
	0.9992	0.9970	0.9882	0.9436	0.8144	0.6149	0.4582	0.5348	0.8226	0.9803	0.9978	0.9994	(86)
MIT	19.4710	19.6945	20.0430	20.5034	20.8362	20.9696	20.9944	20.9883	20.8736	20.3968	19.8473	19.4379	(87)
Th 2	19.9184	19.9203	19.9222	19.9311	19.9328	19.9406	19.9406	19.9420	19.9376	19.9328	19.9294	19.9259	(88)
util rest of house													
	0.9989	0.9959	0.9837	0.9228	0.7569	0.5238	0.3505	0.4177	0.7434	0.9696	0.9969	0.9992	(89)
MIT 2	18.1275	18.4148	18.8595	19.4335	19.8016	19.9246	19.9390	19.9382	19.8531	19.3164	18.6175	18.0903	(90)
Living area fraction										fLA = Living area / (4) =		0.1586	(91)
MIT	18.3406	18.6177	19.0472	19.6032	19.9657	20.0904	20.1064	20.1048	20.0149	19.4877	18.8125	18.3040	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3406	18.6177	19.0472	19.6032	19.9657	20.0904	20.1064	20.1048	20.0149	19.4877	18.8125	18.3040	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9939	0.9786	0.9149	0.7588	0.5373	0.3676	0.4363	0.7500	0.9634	0.9953	0.9987	(94)
Useful gains	1206.0254	1534.2466	1858.0445	2154.5878	2047.8189	1471.8177	956.9422	1004.9421	1468.2459	1479.7617	1235.8129	1128.2250	(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													
	3937.3004	3839.0404	3504.5410	2961.7253	2283.2344	1504.1971	960.6423	1013.4520	1625.6644	2455.0555	3246.8466	3924.2640	(97)
Space heating kWh													
	2032.0686	1548.8214	1224.9934	581.1390	175.1491	0.0000	0.0000	0.0000	0.0000	725.6186	1447.9442	2080.2530	(98a)
Space heating requirement - total per year (kWh/year)												9815.9873	
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													
	2032.0686	1548.8214	1224.9934	581.1390	175.1491	0.0000	0.0000	0.0000	0.0000	725.6186	1447.9442	2080.2530	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9815.9873	
Space heating per m2											(98c) / (4) =	42.0745	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2032.0686	1548.8214	1224.9934	581.1390	175.1491	0.0000	0.0000	0.0000	0.0000	725.6186	1447.9442	2080.2530	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	2201.5911	1678.0297	1327.1868	629.6197	189.7607	0.0000	0.0000	0.0000	0.0000	786.1523	1568.7370	2253.7953	(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													
	265.1824	234.4979	249.3587	220.1247	213.9069	193.3445	191.3902	198.7488	200.6318	222.9744	236.1240	262.4319	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6588	87.5023	87.1379	86.1313	83.6151	79.8000	79.8000	79.8000	79.8000	86.5067	87.4176	87.6921	(217)
Fuel for water heating, kWh/month													
	302.5166	267.9905	286.1657	255.5687	255.8232	242.2863	239.8374	249.0586	251.4183	257.7540	270.1102	299.2652	(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	42.0974	33.7721	30.4080	22.2782	17.2083	14.0594	15.6980	20.4049	26.5039	34.7746	39.2778	43.2674	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-63.4067	-89.6017	-129.0369	-145.2608	-156.6208	-145.9794	-143.9659	-135.7994	-121.5781	-102.3160	-69.7007	-54.7768	(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	-35.2069	-74.1292	-147.5285	-221.9334	-293.9066	-295.6569	-292.3872	-247.5420	-181.2669	-106.3799	-47.1082	-27.8535	(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												10634.8725	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3177.7947	(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)												339.7498	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3328.9425	(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	10909.4746	(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	10634.8725	0.2100	2233.3232	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3177.7947	0.2100	667.3369	(264)
Space and water heating			2900.6601	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	339.7498	0.1443	49.0364	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1358.0432	0.1346	-182.7687	
PV Unit electricity exported	-1970.8993	0.1258	-248.0012	
Total			-430.7699	(269)
Total CO2, kg/year			2530.8559	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.8500	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	10634.8725	1.1300	12017.4059	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3177.7947	1.1300	3590.9080	(278)
Space and water heating			15608.3140	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	339.7498	1.5338	521.1196	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1358.0432	1.4974	-2033.5255	
PV Unit electricity exported	-1970.8993	0.4619	-910.3261	
Total			-2943.8516	(283)
Total Primary energy kWh/year			13315.6828	(286)
Target Primary Energy Rate (TPER)			57.0800	(287)

Full SAP Calculation Printout

Property Reference	1Ja	**Issued on Date**	04/03/2024
Assessment Reference	1Ja - BE LEAN	**Prop Type Ref**	1JA
Property	Unit 1Ja		

SAP Rating	84 B	**DER**	11.59	**TER**	10.74
Environmental	87 B	**% DER < TER**			-7.91
CO_2 Emissions (t/year)	2.34	**DFEE**	45.83	**TFEE**	46.68
Compliance Check	See BREL	**% DFEE < TFEE**			1.82
% DPER < TPER	-18.97	**DPER**	67.24	**TPER**	56.52

Assessor Details	Ms. Jemma McLaughlan	**Assessor ID**	W692-0001
Client	Gary Sugarman, Mr Gary Sugarman		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	67.3500 (1a)	x	2.6900 (2a)	=	181.1715	(1a) - (3a)
Ground floor	66.1500 (1b)	x	2.7000 (2b)	=	178.6050	(1b) - (3b)
First floor	53.5000 (1c)	x	3.1000 (2c)	=	165.8500	(1c) - (3c)
Second floor	46.3000 (1d)	x	2.7300 (2d)	=	126.3990	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	233.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	652.0255	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2584	0.2549	0.2515	0.2341	0.2307	0.2133	0.2133	0.2098	0.2202	0.2307	0.2376	0.2445	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			51.5300	1.0536	54.2941			(27)
Door			3.4400	1.1000	3.7840			(26a)
windows 0.3 (Uw = 1.10)			7.1700	1.0536	7.5546			(27)
RLH01.HOR			1.4400	1.0536	1.5172			(27a)
RLH02.HOR			4.8400	1.0536	5.0996			(27a)
FT01.BASEMENT			67.3500	0.0900	6.0615	110.0000	7408.5000	(28a)
FT05.EXPOSED			6.4100	0.1300	0.8333	20.0000	128.2000	(28b)
WT01.RETAINING	43.8700		43.8700	0.1200	5.2644	140.0000	6141.8000	(29a)
WT05.RENDER	24.9200	8.9600	15.9600	0.1500	2.3940	140.0000	2234.4000	(29a)
WT02.BRICK	126.0900	41.6200	84.4700	0.1500	12.6705	140.0000	11825.8000	(29a)
WT0.MANSARD	43.6100	11.5600	32.0500	0.1500	4.8075	9.0000	288.4500	(29a)
RT01.FLAT ROOF	67.1400	6.2800	60.8600	0.0900	5.4774	9.0000	547.7400	(30)

RT02.FT06	3.9200	3.9200	0.0900	0.3528	9.0000	35.2800	(30)
RT01a.FR DORMER	0.8500	0.8500	0.1500	0.1275	9.0000	7.6500	(30)
Total net area of external elements Aum(A, m2)		384.1600					(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		110.2384			(33)
WT03.SOLID		34.1600	0.0000	0.0000	180.0000	6148.8000	(32)
WT04.FULL FILL		90.9300	0.0000	0.0000	110.0000	10002.3000	(32)
IWT1 - Stud		271.0000			9.0000	2439.0000	(32c)
IWT2 - Blockwork		125.3200			75.0000	9399.0000	(32c)
IFT1 - Timber		159.5100			18.0000	2871.1800	(32d)
ICT1 - Timber		159.5100			9.0000	1435.5900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	60913.6900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		261.0960 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	6.8000	0.0600	0.4080
E2 Other lintels (including other steel lintels)	15.9000	0.6000	9.5400
E3 Sill	7.9350	0.0040	0.0317
E4 Jamb	48.8000	0.0020	0.0976
E22 Basement floor	16.8000	0.2200	3.6960
E5 Ground floor (normal)	9.4500	0.3200	3.0240
E20 Exposed floor (normal)	7.0000	0.3200	2.2400
E21 Exposed floor (inverted)	3.8500	0.3200	1.2320
E6 Intermediate floor within a dwelling	19.5000	0.0010	0.0195
E14 Flat roof	5.7500	0.1600	0.9200
E15 Flat roof with parapet	24.3000	0.1050	2.5515
E16 Corner (normal)	2.4000	0.1800	0.4320
E16 Corner (normal)	5.1000	0.1800	0.9180
E16 Corner (normal)	17.4000	0.0410	0.7134
E17 Corner (inverted - internal area greater than external area)	8.3000	-0.0650	-0.5395
E18 Party wall between dwellings	11.8000	0.0350	0.4130
P1 Party wall - Ground floor	12.6500	0.3200	4.0480
P2 Party wall - Intermediate floor within a dwelling	31.8300	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	0.9000	0.4800	0.4320
P5 Party wall - Roof (insulation at rafter level)	12.7800	0.4800	6.1344
E18 Party wall between dwellings	2.7000	0.2400	0.6480
R11 Upstands or kerbs of rooflights	13.6000	0.2400	3.2640
R7 Flat ceiling (inverted)	1.0000	0.1200	0.1200
E24 Eaves (insulation at ceiling level - inverted)	19.9000	0.1500	2.9850
E4 Jamb	12.4000	0.1000	1.2400
E17 Corner (inverted - internal area greater than external area)	1.0000	0.0000	0.0000
E16 Corner (normal)	15.9600	0.1800	2.8728
E18 Party wall between dwellings	5.3200	0.2400	1.2768
R9 Roof to wall (flat ceiling)	3.8500	0.3200	1.2320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		49.9502 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	160.1887 (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	55.6009	54.8545	54.1081	50.3763	49.6299	45.8981	45.8981	45.1517	47.3908	49.6299	51.1227	52.6154	(38)
Heat transfer coeff	215.7895	215.0432	214.2968	210.5650	209.8186	206.0868	206.0868	205.3404	207.5795	209.8186	211.3113	212.8041	(39)
Average = Sum(39)m / 12 =												210.3784	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9249	0.9217	0.9185	0.9026	0.8994	0.8834	0.8834	0.8802	0.8898	0.8994	0.9057	0.9121	(40)
HLP (average)												0.9018	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0452	(42)
Hot water usage for mixer showers	103.5075	101.9520	99.6853	95.3484	92.1479	88.5787	86.5499	88.7995	91.2654	95.0976	99.5277	103.1109	(42a)
Hot water usage for baths	32.4953	32.0127	31.3331	30.0800	29.1418	28.1014	27.5394	28.2142	28.9490	30.0623	31.3412	32.3855	(42b)
Hot water usage for other uses	45.8161	44.1501	42.4840	40.8180	39.1519	37.4859	37.4859	39.1519	40.8180	42.4840	44.1501	45.8161	(42c)
Average daily hot water use (litres/day)												167.2097	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	181.8189	178.1148	173.5024	166.2464	160.4416	154.1659	151.5752	156.1656	161.0324	167.6439	175.0189	181.3125	(44)
Energy conte	287.9567	253.6331	266.6668	227.5830	215.9852	189.5650	183.3171	193.3657	198.5690	227.4912	249.3465	283.8916	(45)
Energy content (annual)										Total = Sum(45)m =		2777.3710	
Distribution loss (46)m = 0.15 x (45)m	43.1935	38.0450	40.0000	34.1375	32.3978	28.4347	27.4976	29.0049	29.7854	34.1237	37.4020	42.5837	(46)
Water storage loss:													
Store volume												269.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9558	(55)
Total storage loss	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(56)
If cylinder contains dedicated solar storage	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	340.8489	301.4067	319.5590	278.7690	268.8774	240.7510	236.2093	246.2579	249.7550	280.3834	300.5325	336.7838	(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	340.8489	301.4067	319.5590	278.7690	268.8774	240.7510	236.2093	246.2579	249.7550	280.3834	300.5325	336.7838	(64)
										Total per year (kWh/year) = Sum(64)m =		3400.1340	(64)
12Total per year (kWh/year)												3400	(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	138.0594	122.5519	130.9805	116.6202	114.1288	103.9792	103.2667	106.6079	106.9730	117.9546	123.8565	136.7077	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	202.6052	224.3129	202.6052	209.3587	202.6052	209.3587	202.6052	202.6052	209.3587	202.6052	209.3587	202.6052	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	401.6875	405.8558	395.3519	372.9904	344.7630	318.2332	300.5097	296.3414	306.8453	329.2068	357.4342	383.9640	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	(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)													
	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	(71)
Water heating gains (Table 5)													
	185.5637	182.3689	176.0490	161.9724	153.3990	144.4155	138.7993	143.2901	148.5736	158.5411	172.0229	183.7469	(72)
Total internal gains													
	861.5347	884.2158	845.6844	815.9998	772.4455	740.6857	710.5925	710.9151	733.4559	762.0314	810.4942	841.9944	(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	
Northeast	28.5100	11.2829	0.5700	0.7000	0.7700	88.9458	(75)
Southeast	5.9000	36.7938	0.5700	0.7000	0.7700	60.0251	(77)
Southwest	14.2400	36.7938	0.5700	0.7000	0.7700	144.8742	(79)
Northwest	2.8800	11.2829	0.5700	0.7000	0.7700	8.9851	(81)
Northeast	6.2800	26.0000	0.4500	0.7000	1.0000	46.2899	(82)
Northeast	3.4500	11.2829	0.3000	0.7000	0.7700	5.6649	(75)
Southwest	3.7200	36.7938	0.3000	0.7000	0.7700	19.9191	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	374.7042	689.9619	1074.8090	1540.2240	1907.7204	1972.1482	1868.9608	1584.2026	1235.0342	798.4481	458.3837	314.3873	(83)
Total gains	1236.2389	1574.1778	1920.4934	2356.2239	2680.1658	2712.8339	2579.5534	2295.1177	1968.4901	1560.4795	1268.8778	1156.3817	(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	78.4119	78.6841	78.9581	80.3575	80.6433	82.1036	82.1036	82.4020	81.5132	80.6433	80.0737	79.5120	
alpha	6.2275	6.2456	6.2639	6.3572	6.3762	6.4736	6.4736	6.4935	6.4342	6.3762	6.3382	6.3008	
util living area													
	0.9992	0.9960	0.9807	0.8954	0.6991	0.4838	0.3513	0.4108	0.6993	0.9633	0.9972	0.9994	(86)
MIT	19.9053	20.1239	20.4336	20.7967	20.9640	20.9970	20.9997	20.9992	20.9741	20.6847	20.2245	19.8791	(87)
Th 2	20.1463	20.1491	20.1518	20.1653	20.1681	20.1817	20.1817	20.1844	20.1762	20.1681	20.1626	20.1572	(88)
util rest of house													
	0.9989	0.9947	0.9742	0.8670	0.6459	0.4231	0.2861	0.3384	0.6271	0.9471	0.9961	0.9993	(89)
MIT 2	19.1366	19.3566	19.6637	20.0125	20.1468	20.1805	20.1816	20.1842	20.1637	19.9221	19.4685	19.1193	(90)
Living area fraction										fLA = Living area / (4) =		0.1586	(91)
MIT	19.2585	19.4783	19.7858	20.1369	20.2764	20.3100	20.3113	20.3134	20.2923	20.0430	19.5884	19.2398	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1085	19.3283	19.6358	19.9869	20.1264	20.1600	20.1613	20.1634	20.1423	19.8930	19.4384	19.0898	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9928	0.9691	0.8600	0.6431	0.4215	0.2845	0.3365	0.6240	0.9402	0.9946	0.9989	(94)
Useful gains	1234.1893	1562.8985	1861.1718	2026.4561	1723.5488	1143.3345	733.7915	772.3502	1228.3012	1467.1343	1262.0599	1155.0997	(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													
	3195.5178	3102.7101	2814.9672	2334.5031	1768.0155	1145.8371	733.9452	772.7868	1254.2489	1949.8506	2607.2481	3168.6092	(97)
Space heating kWh													
	1459.2284	1034.7534	709.6238	221.7938	33.0832	0.0000	0.0000	0.0000	0.0000	359.1409	968.5356	1498.0511	(98a)
Space heating requirement - total per year (kWh/year)												6284.2102	
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													
	1459.2284	1034.7534	709.6238	221.7938	33.0832	0.0000	0.0000	0.0000	0.0000	359.1409	968.5356	1498.0511	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6284.2102	
Space heating per m2											(98c) / (4) =	26.9362	(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	1937.2156	1525.0421	1560.5871	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9782	0.9918	0.9829	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1894.9336	1512.5109	1533.8368	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2996.6278	2848.4665	2528.3883	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	793.2199	993.9510	739.9463	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.4715	(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	93.5000	117.1610	87.2204	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												297.8814	(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)
Efficiency of main space heating system 1 (in %)												83.0800	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												5.1000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1459.2284	1034.7534	709.6238	221.7938	33.0832	0.0000	0.0000	0.0000	0.0000	359.1409	968.5356	1498.0511	(98)
Space heating efficiency (main heating system 1)													
	83.0800	83.0800	83.0800	83.0800	83.0800	0.0000	0.0000	0.0000	0.0000	83.0800	83.0800	83.0800	(210)
Space heating fuel (main heating system)													
	1756.4136	1245.4904	854.1451	266.9641	39.8209	0.0000	0.0000	0.0000	0.0000	432.2833	1165.7867	1803.1428	(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													
	340.8489	301.4067	319.5590	278.7690	268.8774	240.7510	236.2093	246.2579	249.7550	280.3834	300.5325	336.7838	(64)
Efficiency of water heater												79.8000	(216)
(217)m	81.3828	81.0656	80.3309	78.2684	75.6304	74.8000	74.8000	74.8000	74.8000	79.2475	80.9676	81.4339	(217)
Fuel for water heating, kWh/month													
	418.8217	371.8060	397.8034	356.1708	355.5148	321.8596	315.7878	329.2218	333.8971	353.8072	371.1761	413.5672	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	18.3333	22.9727	17.1020	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	94.4209	85.2834	94.4209	91.3751	94.4209	91.3751	94.4209	94.4209	91.3751	94.4209	91.3751	94.4209	(231)
Lighting	38.1080	30.5717	27.5264	20.1670	15.5776	12.7270	14.2104	18.4712	23.9923	31.4792	35.5556	39.1671	(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												7564.0469	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												4339.4335	(219)
Space cooling fuel												58.4081	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2740)													
mechanical ventilation fans (SFP = 1.2740)												1013.4302	(230a)
central heating pump												53.3000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												1111.7302	(231)
Electricity for lighting (calculated in Appendix L)												307.5535	(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												13381.1722	(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	7564.0469	0.2100	1588.4498	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4339.4335	0.2100	911.2810	(264)
Space and water heating			2499.7309	(265)
Space cooling	58.4081	0.1141	6.6654	(266)
Pumps, fans and electric keep-hot	1111.7302	0.1387	154.2107	(267)
Energy for lighting	307.5535	0.1443	44.3895	(268)
Total CO2, kg/year			2704.9964	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.5900	(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	7564.0469	1.1300	8547.3730	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4339.4335	1.1300	4903.5599	(278)
Space and water heating			13450.9329	(279)
Space cooling	58.4081	1.4206	82.9751	(280)
Pumps, fans and electric keep-hot	1111.7302	1.5128	1681.8254	(281)
Energy for lighting	307.5535	1.5338	471.7358	(282)
Total Primary energy kWh/year			15687.4691	(286)
Dwelling Primary energy Rate (DPER)			67.2400	(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)	
Basement floor	67.3500	(1a)	x 2.6900	(2a) =	181.1715	(1a) - (3a)
Ground floor	66.1500	(1b)	x 2.7000	(2b) =	178.6050	(1b) - (3b)
First floor	53.5000	(1c)	x 3.1000	(2c) =	165.8500	(1c) - (3c)
Second floor	46.3000	(1d)	x 2.7300	(2d) =	126.3990	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	233.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		652.0255	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0613 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3113 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2880 (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	0.3672	0.3600	0.3528	0.3168	0.3096	0.2736	0.2736	0.2664	0.2880	0.3096	0.3240	0.3384	(22b)
Effective ac	0.5674	0.5648	0.5622	0.5502	0.5479	0.5374	0.5374	0.5355	0.5415	0.5479	0.5525	0.5573	(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 Semi-glazed door			3.4400	1.0000	3.4400			(26a)
TER Opening Type (Uw = 1.20)			49.5800	1.1450	56.7710			(27)
RLH01.HOR			1.2200	2.0221	2.4669			(27a)
RLH02.HOR			4.0900	2.0221	8.2702			(27a)
FT01.BASEMENT			67.3500	0.1300	8.7555			(28a)
FT05.EXPOSED			6.4100	0.1300	0.8333			(28b)
WT01.RETAINING	43.8700		43.8700	0.1800	7.8966			(29a)
WT05.RENDER	24.9200	7.5700	17.3500	0.1800	3.1230			(29a)
WT02.BRICK	126.0900	35.6900	90.4000	0.1800	16.2720			(29a)
WT0.MANSARD	43.6100	9.7600	33.8500	0.1800	6.0930			(29a)
RT01.FLAT ROOF	67.1400	5.3100	61.8300	0.1100	6.8013			(30)
RT02.FT06	3.9200		3.9200	0.1100	0.4312			(30)
RT01a.FR DORMER	0.8500		0.8500	0.1100	0.0935			(30)
Total net area of external elements Aum(A, m2)			384.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		121.2475			(33)
WT03.SOLID			34.1600	0.0000	0.0000			(32)
WT04.FULL FILL			90.9300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 261.0960 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.8000	0.0500	0.3400
E2 Other lintels (including other steel lintels)	15.9000	0.0500	0.7950
E3 Sill	7.9350	0.0500	0.3967
E4 Jamb	48.8000	0.0500	2.4400
E22 Basement floor	16.8000	0.0700	1.1760
E5 Ground floor (normal)	9.4500	0.1600	1.5120
E20 Exposed floor (normal)	7.0000	0.3200	2.2400
E21 Exposed floor (inverted)	3.8500	0.3200	1.2320
E6 Intermediate floor within a dwelling	19.5000	0.0000	0.0000
E14 Flat roof	5.7500	0.0800	0.4600
E15 Flat roof with parapet	24.3000	0.5600	13.6080
E16 Corner (normal)	2.4000	0.0900	0.2160
E16 Corner (normal)	5.1000	0.0900	0.4590
E16 Corner (normal)	17.4000	0.0900	1.5660
E17 Corner (inverted - internal area greater than external area)	8.3000	-0.0900	-0.7470
E18 Party wall between dwellings	11.8000	0.0600	0.7080
P1 Party wall - Ground floor	12.6500	0.0800	1.0120
P2 Party wall - Intermediate floor within a dwelling	31.8300	0.0000	0.0000
P7 Party Wall - Exposed floor (normal)	0.9000	0.1600	0.1440
P5 Party wall - Roof (insulation at rafter level)	12.7800	0.0800	1.0224
E18 Party wall between dwellings	2.7000	0.0600	0.1620
R11 Upstands or kerbs of rooflights	13.6000	0.0800	1.0880

R7 Flat ceiling (inverted)	1.0000	0.0400	0.0400	
E24 Eaves (insulation at ceiling level - inverted)	19.9000	0.2400	4.7760	
E4 Jamb	12.4000	0.0500	0.6200	
E17 Corner (inverted - internal area greater than external area)	1.0000	-0.0900	-0.0900	
E16 Corner (normal)	15.9600	0.0900	1.4364	
E18 Party wall between dwellings	5.3200	0.0600	0.3192	
R9 Roof to wall (flat ceiling)	3.8500	0.0400	0.1540	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 37.0857 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 158.3333 (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	122.0900	121.5268	120.9746	118.3813	117.8961	115.6374	115.6374	115.2191	116.5074	117.8961	118.8777	119.9038	(38)
Heat transfer coeff	280.4233	279.8600	279.3079	276.7146	276.2294	273.9707	273.9707	273.5524	274.8407	276.2294	277.2109	278.2371	(39)
Average = Sum(39)m / 12 =												276.7123	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2020	1.1996	1.1972	1.1861	1.1840	1.1743	1.1743	1.1725	1.1781	1.1840	1.1882	1.1926	(40)
HLP (average)												1.1861	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0452 (42)
Hot water usage for mixer showers

75.2782	74.1469	72.4984	69.3443	67.0166	64.4209	62.9454	64.5814	66.3748	69.1619	72.3838	74.9898	(42a)

Hot water usage for baths

32.4953	32.0127	31.3331	30.0800	29.1418	28.1014	27.5394	28.2142	28.9490	30.0623	31.3412	32.3855	(42b)

Hot water usage for other uses

45.8161	44.1501	42.4840	40.8180	39.1519	37.4859	37.4859	39.1519	40.8180	42.4840	44.1501	45.8161	(42c)

Average daily hot water use (litres/day) 141.1833 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.5896	150.3097	146.3155	140.2423	135.3103	130.0081	127.9707	131.9476	136.1418	141.7082	147.8750	153.1913	(44)
Energy conte	243.2484	214.0390	224.8815	191.9847	182.1537	159.8601	154.7695	163.3787	167.8765	192.2967	210.6750	239.8606	(45)
Energy content (annual)										Total = Sum(45)m =		2345.0245	
Distribution loss (46)m = 0.15 x (45)m	36.4873	32.1058	33.7322	28.7977	27.3231	23.9790	23.2154	24.5068	25.1815	28.8445	31.6013	35.9791	(46)
Water storage loss:													
Store volume												269.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9764	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0673	(55)
Total storage loss	33.0856	29.8838	33.0856	32.0184	33.0856	32.0184	33.0856	33.0856	32.0184	33.0856	32.0184	33.0856	(56)
If cylinder contains dedicated solar storage	33.0856	29.8838	33.0856	32.0184	33.0856	32.0184	33.0856	33.0856	32.0184	33.0856	32.0184	33.0856	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	299.5964	264.9340	281.2296	246.5151	238.5018	214.3905	211.1175	219.7267	222.4068	248.6447	265.2054	296.2086	(62)
WWHRS	-34.4141	-30.4361	-31.8709	-26.3904	-24.5949	-21.0460	-19.7273	-20.9780	-21.7750	-25.6703	-29.0814	-33.7768	(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	265.1824	234.4979	249.3587	220.1247	213.9069	193.3445	191.3902	198.7488	200.6318	222.9744	236.1240	262.4319	(64)
										Total per year (kWh/year) = Sum(64)m =		2688.7162	(64)
12Total per year (kWh/year)												2689	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	125.9585	111.8840	119.8515	107.4592	105.6445	96.7778	96.5393	99.4018	99.4432	109.0171	113.6737	124.8321	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	152.2610	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	202.6052	224.3129	202.6052	209.3587	202.6052	209.3587	202.6052	202.6052	209.3587	202.6052	209.3587	202.6052	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	401.6875	405.8558	395.3519	372.9904	344.7630	318.2332	300.5097	296.3414	306.8453	329.2068	357.4342	383.9640	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	38.2261	(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)	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	-121.8088	(71)
Water heating gains (Table 5)	169.2991	166.4940	161.0908	149.2489	141.9953	134.4136	129.7571	133.6046	138.1156	146.5283	157.8802	167.7851	(72)
Total internal gains	845.2701	868.3410	830.7262	803.2763	761.0418	730.6838	701.5503	701.2296	722.9979	750.0187	796.3514	826.0325	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	26.9900	11.2829	0.6300	0.7000	0.7700	93.0673	(75)
Southeast	4.9900	36.7938	0.6300	0.7000	0.7700	56.1109	(77)
Southwest	15.1700	36.7938	0.6300	0.7000	0.7700	170.5817	(79)
Northwest	2.4300	11.2829	0.6300	0.7000	0.7700	8.3792	(81)
Northeast	5.3100	26.0000	0.6300	0.7000	1.0000	54.7960	(82)

Solar gains	382.9351	706.4457	1102.7015	1581.7643	1959.1955	2025.0464	1919.2413	1627.0484	1267.7819	818.2220	468.7202	321.1062	(83)

Total gains	1228.2052	1574.7866	1933.4276	2385.0406	2720.2373	2755.7302	2620.7915	2328.2780	1990.7798	1568.2407	1265.0716	1147.1388	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.3390	60.4605	60.5800	61.1477	61.2551	61.7601	61.7601	61.8546	61.5646	61.2551	61.0382	60.8131	
alpha	5.0226	5.0307	5.0387	5.0765	5.0837	5.1173	5.1173	5.1236	5.1043	5.0837	5.0692	5.0542	
util living area													
	0.9991	0.9967	0.9873	0.9411	0.8108	0.6119	0.4553	0.5296	0.8152	0.9785	0.9976	0.9994	(86)
MIT	19.4798	19.7079	20.0574	20.5132	20.8397	20.9702	20.9945	20.9888	20.8792	20.4095	19.8574	19.4456	(87)
Th 2	19.9184	19.9203	19.9222	19.9311	19.9328	19.9406	19.9406	19.9420	19.9376	19.9328	19.9294	19.9259	(88)
util rest of house													
	0.9988	0.9955	0.9825	0.9196	0.7529	0.5210	0.3482	0.4134	0.7349	0.9671	0.9966	0.9991	(89)
MIT 2	18.1387	18.4319	18.8775	19.4448	19.8048	19.9250	19.9390	19.9384	19.8575	19.3319	18.6305	18.1001	(90)
Living area fraction										fLA = Living area / (4) =		0.1586	(91)
MIT	18.3514	18.6343	19.0646	19.6142	19.9689	20.0908	20.1064	20.1050	20.0195	19.5028	18.8251	18.3135	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3514	18.6343	19.0646	19.6142	19.9689	20.0908	20.1064	20.1050	20.0195	19.5028	18.8251	18.3135	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9933	0.9771	0.9117	0.7551	0.5344	0.3652	0.4318	0.7420	0.9607	0.9949	0.9986	(94)
Useful gains	1225.7803	1564.2967	1889.1538	2174.3440	2054.0040	1472.6916	957.0735	1005.3928	1477.0811	1506.5384	1258.5853	1145.5219	(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													
	3940.3296	3843.6705	3509.3864	2964.7755	2284.1231	1504.3146	960.6608	1013.5143	1626.9187	2459.2037	3250.3223	3926.8974	(97)
Space heating kWh													
	2019.6247	1531.7392	1205.4531	569.1107	171.2086	0.0000	0.0000	0.0000	0.0000	708.7830	1434.0507	2069.3434	(98a)
Space heating requirement - total per year (kWh/year)												9709.3134	
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													
	2019.6247	1531.7392	1205.4531	569.1107	171.2086	0.0000	0.0000	0.0000	0.0000	708.7830	1434.0507	2069.3434	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9709.3134	
Space heating per m2											(98c) / (4) =	41.6173	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2019.6247	1531.7392	1205.4531	569.1107	171.2086	0.0000	0.0000	0.0000	0.0000	708.7830	1434.0507	2069.3434	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	2188.1091	1659.5224	1306.0163	616.5880	185.4915	0.0000	0.0000	0.0000	0.0000	767.9122	1553.6844	2241.9755	(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													
	265.1824	234.4979	249.3587	220.1247	213.9069	193.3445	191.3902	198.7488	200.6318	222.9744	236.1240	262.4319	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6526	87.4900	87.1160	86.0919	83.5652	79.8000	79.8000	79.8000	79.8000	86.4663	87.4063	87.6870	(217)
Fuel for water heating, kWh/month													
	302.5378	268.0284	286.2377	255.6857	255.9760	242.2863	239.8374	249.0586	251.4183	257.8743	270.1452	299.2826	(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	42.0974	33.7721	30.4080	22.2782	17.2083	14.0594	15.6980	20.4049	26.5039	34.7746	39.2778	43.2674	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-63.4067	-89.6017	-129.0369	-145.2608	-156.6208	-145.9794	-143.9659	-135.7994	-121.5781	-102.3160	-69.7007	-54.7768	(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	-35.2069	-74.1292	-147.5285	-221.9334	-293.9066	-295.6569	-292.3872	-247.5420	-181.2669	-106.3799	-47.1082	-27.8535	(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												10519.2995	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3178.3683	(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)												339.7498	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3328.9425	(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	10794.4751	(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	10519.2995	0.2100	2209.0529	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3178.3683	0.2100	667.4574	(264)
Space and water heating			2876.5102	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	339.7498	0.1443	49.0364	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1358.0432	0.1346	-182.7687	
PV Unit electricity exported	-1970.8993	0.1258	-248.0012	
Total			-430.7699	(269)
Total CO2, kg/year			2506.7060	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7400	(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	10519.2995	1.1300	11886.8084	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3178.3683	1.1300	3591.5562	(278)
Space and water heating			15478.3646	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	339.7498	1.5338	521.1196	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1358.0432	1.4974	-2033.5255	
PV Unit electricity exported	-1970.8993	0.4619	-910.3261	
Total			-2943.8516	(283)
Total Primary energy kWh/year			13185.7334	(286)
Target Primary Energy Rate (TPER)			56.5200	(287)