Energy and Sustainability Strategy

114 Cowley Road, Littlemore, Oxford, Oxfordshire, OX4 3TJ

PR10986

Date: 27/09/2023

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Notice

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Contents

Executive summary

ERS Consultants Ltd has been appointed to prepare an Energy & Sustainability Statement for the site located at 114 Cowley Road, Littlemore, Oxford, Oxfordshire, OX4 3TJ.

The proposal is for the development of a house. This report will be focusing on implementing careful design and sustainable measures; so that the project creates an attractive new residential unit which will address current housing need within the development area.

Proposed schedules of accommodation are as follows:

Total Number of Dwellings = 2 Flats

2 Flats

- Type = 2 x 2 Bedroom property

Total combined floor area for habitable dwellings: 129.11m²

This energy and sustainability strategy outlines the key measures to be incorporated in the design, in regards to sustainability, carbon emissions, renewable energy and environmental impact of the considered development in accordance and with guidance from the following documents and policies:

- Oxford City local plan (Policy RE1)
- The National Planning Policy Framework (NPPF) July 2021

In line with Oxford City Local plan Policy RE1, the development would need to achieve a 40% reduction in regulated CO_2 emissions, this development uses an approach to use the carbon factors and figures that have been determined in the latest Part L1 2021 which is a 31% improvement over carbon in comparison to Building Part L 2013.

SAP 10 calculations have been used as this development will effectively be completed on the current Building regulation standards.

This energy & sustainability statement will demonstrate how a selection of sustainable energy efficient measures and low-carbon technologies are used in the reduction of carbon emissions for the development.

A detailed calculation has been undertaken to establish the energy consumption and carbon emissions of the proposed development.

The methodology used to determine the expected operational CO_2 emissions for the development is in accordance with the standard three-step Energy Hierarchy and the CO_2 savings achieved for each step are outlined below:

Baseline – (CO2 emissions Part L of the Building Regulation)

Initially in the energy assessment, it must be established that the regulated CO_2 emissions of the development comply with Part L SAP10 Standards of the Building Regulations using the approved compliance software for SAP. The baseline regulated CO2 emissions calculated for the site **1.36 Tonnes CO_2/Year.**

Be Lean – Use less energy

The second step addresses, reduction in energy demand, through the adoption of passive and active design measures with emphasis on a fabric first approach.

Emphasis will be put on the buildings fabric performance in order to reduce energy consumption, as less heating and cooling will be lost through the high performance fabric hence reducing the demand. Fabric first measures include levels of insulation beyond Building Regulation 2021 requirements which will help in achieving low air tightness levels.

With the addition of the lean fabric improvements the energy regulated CO_2 emissions are shown to reduce by **11.73% (1.20 Tonnes CO_2/Year)** for the proposed site.

Be Clean – Supply energy efficiently

Once demand for energy has been minimised, all planning applications must demonstrate how their energy systems will exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly to reduce CO2 emissions.

When selecting the proposed heating system, it is imperative to consider carbon dioxide emissions, as all combustion processes can emit oxides of Nitrogen (NOx) and, solid or liquid fueled appliances (such as those using biomass or biodiesel) can also emit Particulate Matter. These pollutants contribute to Oxford's poor air quality and can have negative impacts on the health of local residents and occupiers of the development. It is important that these impacts are taken into account in determining the heating strategy of a development.

In this development a combination of a highly efficient Air Source Heat Pump and gas combi boiler have been proposed as the main heatings and hot water system, due to the nature of the site.

The space conditioning and hot water system network in this stage of the development will have no changes as there is no need to better the proposed systems applied at the previous development stage of the project.

In this project there will be no direct heating networks or CHP incorporated so therefore, the Be Clean scenario will not further reduce CO2 emissions on site for the proposed development, therefore meaning there are no changes to be implemented to the development.

There is no change from the previous stage and the CO2 emissions remain the same at **11.73% (1.20 Tonnes CO_2/Year)** for the proposed site.

Be Green – Use renewable energy

At this stage of the project, various low-zero carbon options were considered to meet the required reduction. In the end it was decided that a combination of an electric and gas heating system would be used as stated in the previous step.

At this stage, the Air Source Heat Pump within flat 1 will have an MCS installation certificate. Flat 2, with the gas combi boiler, will have PV panels on the southwest facing sloped roof.

By implementing this change, the regulated carbon emissions have been reduced by **40.80% (0.81 Tonnes CO_2/Year)** from the baseline.

This concludes this proposed development using the proposed specification in this report completes the **40% Carbon Emissions Reduction** against **future Part L Building Regulations standards by using the Part L 2021 carbon emission factors**.

This development has taken this approach to compliance as the development is to be completed under Part L 2021.

Energy & carbon demand summary

Table 1 Energy and Carbon Reductions for Site Wide Reduction				
	Primary energy kWh/year	**Energy Consumption Savings (%)**	**Total CO_2 Emissions (Tonnes CO_2/Year)**	**CO_2 Emissions Savings (%)**
Baseline	7,180		1.36	
Be Lean	8,263	-15.10%	1.20	11.73%
Be Clean	8,263	00.00%	1.20	00.00%
Be Green	5,603	37.06%	0.81	29.07%
Total Reduction		**21.96%**		**40.80%**

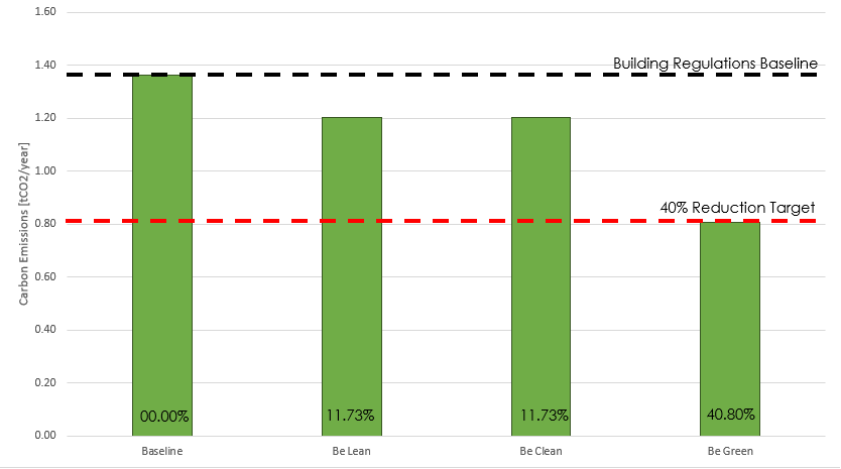


Fig.1 CO_2 Reduction for Site-wide carbon reduction

SAP calculations always refer to 'regulated' energy loads, which are those addressed by building regulations, 'unregulated' loads, for example is energy used by white goods and cooking.

As shown in Table 1, the provisional baseline annual carbon dioxide emissions of the proposed development have been calculated to achieve **1.36 Tonnes CO_2/Year** for the site and through the design development this has been reduced to **40.80% (0.81 Tonnes CO_2/Year).**

Table 2: Proposed Fabric Specifications			
Fabric Construction and Insulation			
Element	**Type**	**U-Value**	
Heat Loss Floor	Ground Floor - Solid	0.12	
External Walls	Cavity Wall	0.18	
Plane Roof	Pitched – insulated at joists	0.10	
Roof	Pitched – insulated at rafters	0.15	
Windows	Window	Double glazed, argon filled, 16mm unit with low-e coat and thermally broken lintel, IG or similar; G-Value of 63%; Frame Factor of 80%;	1.20
Rooflights	Roof Window	Double glazed, argon filled, 16mm unit with low-e coat and thermally broken lintel, IG or similar; G-Value of 63%; Frame Factor of 80%;	1.20
Solid Door	Solid Door	Solid or minimally glazed (<30%) insulated unit with thermally broken lintel;	1.20

Table 3: Proposed System Specifications						
Space Heating						
Main Heating System	Flat 1: SAP default Air Source Heat Pump used for Energy Statement calculations; Radiators; Flat 2: Gas combi boiler; Worcester Greenstar 8000 30kW used for Energy Statement calculations; Radiators;					
Heating Controls	Time and temperature zone control;					
Secondary Heating	N/A;					
Water Heating						
Heat source	From Main Heating	**Cylinder Size**	**Flat 1 only:** 170l	**Heat Loss**	**Flat 1 only:** 1.63 kWh/Day	
WWHRS Instantaneous System 1	N/A	**WWHRS Instantaneous System 2**	N/A			
Water Use <=125 l/p/d	Yes	**Cold Water Source**	From Mains			
Shower(s) – Flat 1	Instantaneous electric shower	**Flow Rate [l/min]**	9 l/min	Connected to the Hot Water Cylinder		
Shower(s) – Flat 2	Combination boiler or unvented hot water system	**Flow Rate [l/min]**	9 l/min	Connected to the Hot Water Cylinder		
Bath Count	2	Cylinder Pipework is fully insulated where possible; Full cylinder heating controls installed;				
Solar Thermal	Not Installed;					
Ventilation						
Mechanical Ventilation System	Intermittent Extract;	**Number of Wetrooms, excluding kitchen**	Flat 1: 1 Flat 2: 2			
Cooling system	Not installed;					
Pressure Test Blower Door	5.00m³/hm² @ 50 Pa Please note ERS can provide Air Leakage Testing					
Other						
Detailing (linear thermal bridging junctions – formerly ACDs)	Enhanced construction details from the insulation manufacturer have been used where available. The dwelling must be constructed to this standard, and the relevant forms must be completed as building work progresses. Any deviation from this will require an update to the SAP calculations as the psi-values will change; **Building Alliance Recognised Construction Details used throughout; 150mm/0.032W/mK/0.19W/mK. Unilin Psi values used for R1/R2/R3 junctions;**					
Lighting	**No. Fittings** 16	**Power [W]** 2	**Efficacy [lm/W]** 75	**Capacity [lm]** 150		
Tariff and Meters	Standard	**Smart Electricity Meter**	Yes	**Smart Gas Meter (Flat 2)**	Yes	
PV/Renewables	3.5kWp PV on Southwest facing sloped roof; Export Capable Meter;					

Please note: There may be upgrades compared to your original specification to achieve building regulation approval under the relevant Approved Document Part L. Failure to implement these upgrades may result in a Building Regulation Failure at final stage. Please ensure any changes to the specification are made through this office to ensure ongoing compliance.

Introduction

Site & proposal

The site is located at **114 Cowley Road, Littlemore, Oxford, Oxfordshire, OX4 3TJ**

Gross Internal Area for the dwelling: 129.11m²

The approximate site location of the proposed development is shown in the site plan Fig.2.

Fig.2 Site Plan

Policy context

This energy and sustainability statement will seek to respond to the energy policies that apply to this development. The most relevant applicable energy policies in the context of the proposed development are presented below.

- Oxford City local plan (Policy RE1)
- The National Planning Policy Framework (NPPF) July 2021

All the aforementioned policies focus on zero carbon targets for residential developments with a minimum 40 per cent on site reduction beyond Part L 2021.

Calculation methodology

The sections below present the methodology followed in determining carbon emissions reduction savings for the proposed scheme.

The methodology employed by the energy and sustainability statement is in line with the GLA's Guidance on preparing energy assessments.

The baseline CO_2 emissions are first established, i.e., the emissions of a scheme that is compliant with Part L 2021 of the Building Regulations.

The approved software used to model and calculates the energy performance and carbon emissions are SAP 10 Online version by Elmhurst Energy Systems Ltd.

To calculate our results for the site-wide development a suitable sample number of units is selected and the results are scaled up as per the proposed development Gross Internal Area.

The TER which is used as the baseline figure for the carbon reductions for each domestic element is multiplied by its floor area to establish the total baseline emissions.

Baseline:

The property baseline uses the same heating system as per the designed counterpart; therefore, in this exercise the baseline models also use Mains Gas as the main source of heating on the calculations. The full specification of the baseline can be found in Table 1.1 of the Approved Document L Volume, 2021 Edition.

Be Lean: use less energy

The demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the dwelling fabric u-values and glazing have been improved to a high standard, in addition to this suitable heating systems are utilised as per the specifications in Table 2 and 3.

Be Clean: supply energy efficiently

As much of the remaining energy demand is supplied as efficiently as possible in the previous stage, we consider the option of communal and network-based heating strategies, but due to high costs and the scale of the development this is not a viable option.

Be Green: use renewable energy

Renewable and low-zero carbon technologies are incorporated to offset part of the carbon emissions of the development. The uptake of renewable technologies is based

on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site.

The 40% improvement for the development against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall; savings through off-site measures should be achieved.

The Conclusions section summarizes the energy strategy and associated carbon savings for the proposed development.

The carbon emissions factors used in all calculations in this document are those used for Part L of the Building Regulations. The relevant factors are reproduced in Table 4 below.

Table 4 Carbon Emission Factors for selected fuel type

Fuel	Emissions kg CO2e per kWh	Primary energy factor
Mains Gas	0.210	1.130
Bulk/Bottled LPG	0.241	1.141
Liquid Fuels	0.024	1.286
Heating Oil	0.298	1.180
Wood Pellets	0.053	1.325
Grid Electricity	0.136	1.501

* Table extracted from the document SAP Version 10.2 (21-04-2022). Table 12: Fuel prices, emission factors and primary energy factors, Page 189. this can be found in the appendix of the report.

Be Lean – Use less energy

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, and lighting.

Measures will also be put in place to reduce the risk of overheating, the regulated carbon saving achieved in this step of the Energy Hierarchy is 11.73% when compared against the baseline level for the development.

Passive design measures

Materials and Waste

A site waste management plan that provides details of waste minimisation, sorting, reuse and recycling procedures is required for all levels in the planning guidance. Sustainable waste management should follow the hierarchy described in *BS 5906: Waste management in buildings. Code of practice*. This outlines the following principles in decreasing order of desirability:

- Reuse land and buildings wherever feasible and consistent with maintaining and enhancing local character and distinctiveness.
- Reuse and recycle materials that arise through demolition and refurbishment, including the reuse of excavated soil and hardcore within the site.
- Prioritise the use of materials and construction techniques that have smaller ecological and carbon footprints, help to sustain or create good air quality, and improve resilience to a changing climate where appropriate.
- Incorporate green roofs and/or walls into the structure of buildings where technically feasible to improve water management in the built environment, provide space for biodiversity and aid resilience and adaptation to climate change.
- Consider the lifecycle of the building and public spaces, including how they can be easily adapted and modified to meet changing social and economic needs and how materials can be recycled at the end of their lifetime.

Space is provided and appropriately designed to foster greater levels of recycling of domestic waste.

Using Recycled/Recyclable Materials and Sourcing them Responsibly

The following measures will be put in place to minimise environmental impact

Regard for reuse & efficient use of materials: Material efficiency will be a priority for the design team and will be one of the key considerations during detailed design. Potential measures for reducing the material demand and for designing out waste will be explored by all key design team disciplines at each design stage, according to the first stages of the Waste Hierarchy.

Regard will be given to reducing the use of virgin materials, such as ensuring a recycled aggregate of content 10-15% in concrete, for example.

Specifically, the following notes have been made on the durability and recycling potential of project materials:

- Brick in the wall finishes has a long usable life and can be reclaimed / re-used in the future. It can also be recycled although it is a more a down-cycle into rubble material for aggregates.
- Window glass, carpeting, and concrete can also be down-cycled.
- The hard landscaping has many timber elements (seats, benches, fences, the acoustic fence) which is a renewable material and is likely to be FSC certified. It can also be recycled or down-cycled into chipboard / crushed timber.
- Off-site construction and Prefabrication; An effective way of managing materials efficiency is through off-site construction or 'Prefabrication', meaning that major components of buildings are manufactured off-site and assembled on-site. This has many benefits, as factory environments help to ensure quality of construction, reduce waste because of spoilage on site (e.g., due to poor storage practices or inclement weather) and encouraging the re-use of materials that otherwise may be wasted. This will be actively explored particularly in relation to the houses.
- Similarly, the use of pre-made sections, such as pre-cast floor slabs in the flatted element will reduce waste and maximise material efficiency. A study by the HSE concluded that waste reductions approaching 70% were possible when compared with traditional techniques.
- The design seeks to use prefabrication for some internal spaces and will be used, subject to the availability of skilled labour and resources within a reasonable distance of the site.

- The design utilises stacking, repeating floor plans where possible within the site constraints, making the use of modular construction possible. If this is a viable option it would reduce transport journeys, reduce site congestion and increase safety.

Environmentally conscious materials

- Materials with the lowest environmental impact tend to have only minimal processing requirements and contain as many naturally occurring constituents as possible. The design team will ensure that 'good practice' is implemented in the specification of materials, making conscious decisions to specify more natural products and wider environmental impact of the materials will be considered when choosing between different options. This could include reviewing Environmental Product Declarations.

- Furthermore, efforts will be made to use materials with low/zero Global Warming Potential (GWP), low Ozone Depletion Potential (ODP) and low embodied energy.

- Local and responsible sourcing Transport associated with extracting, processing and delivering materials can contribute significantly to their carbon and environmental footprint. A robust system of responsible materials sourcing will ensure that native materials will be used as a matter of preference, before any are sourced internationally. It is reasonable to expect as well that deliveries will be made using fuel efficient vehicles.

- The responsible sourcing of materials will be a key consideration in the selection of suppliers, and a sustainable procurement strategy will be produced for the development prior to construction.

- Materials from suppliers who participate in responsible sourcing schemes such as the BRE BES 6001:2008 Responsible Sourcing Standard will be prioritised where economically possible.

Where there are suitable opportunities to recycle a proportion of the material recovered from the existing site it should always be done.

Enhanced U-values

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-Values provide better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2021 targets and notional building specifications, to reduce the demand for space conditioning (heating and/or cooling).

Table 5 demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements.

Table 5 Proposed fabric U-Values		
Domestic (U-Values in W/m²k)		
Element	**Part L 2021 Building Regulation**	**Proposed**
Wall	0.26	0.18 (External Wall)
Roof	0.16	0.15 (Sloped Roof) 0.10 (Plane Roof)
Floor	0.18	0.12 (Ground Floor)
Windows/ Doors	1.60	1.20
Rooflights	2.20	1.20
These u-values are recommended but may change during the construction stage, to meet site constraints, any worsening of the u-values must ensure the required 40% reduction in Carbon is met before completion;		

Air tightness improvement

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2021 minimum standards for air tightness by targeting air permeability rates of **5.00m³/m².h at 50Pa for the unit**, should the air test be below 3.00m³/m².h at 50Pa Mechanical ventilation will be required.

Reducing the need for artificial lighting

The development has been designed to maximize daylight in all habitable spaces as a way of improving the health and wellbeing of its occupants.

Natural light Natural lighting reduces the energy used for artificial lighting and creates a healthier internal environment. Issues to consider include how much of the sky is visible through a window (the more, the better), the dimensions of the interior living/working space and distance from the window, and the proportion of glazed surfaces. The depth of the room is an important factor in determining the amount of natural light received. Naturally dark rooms may be lit naturally through measures such as sun tubes which 'pipe' sunlight from sunny areas to internal areas.

Glare created by natural or artificial light can be uncomfortable for people both inside and outside a building. This can be minimised if considered early in the design process through building layout (e.g., low eaves height) or building design (e.g. blinds, brise soleil screening). If considered together with a lighting strategy this can reduce energy consumption.

All of the habitable areas will benefit from suitable level glazed fenestration to increase the amount of daylight within the internal spaces where possible. This is expected to reduce the need for artificial lighting whilst delivering pleasant, healthy spaces for occupants.

Active design measures

High efficacy & low energy lighting

Where artificial lighting will be needed it will low energy lighting without compensating for luminance, and will accommodate LED.

Water

Policy RE1 requires water efficiency in new development to meet the highest national standard. For residential development, this is defined in the supporting text as the 'optional Building Regulation' for water efficiency in new dwellings, which is 125 litres per day per person, or a tighter standard if one becomes available nationally. If a new, tighter national standard is introduced, this will be adopted automatically by virtue of Policy RE1.

There are presently no other national standards for non-residential developments than those in the Building Regulations. However, the principle of water efficiency in line with the waste hierarchy applies to all developments. As a result, all developments should seek to reduce demand through efficiency measures, and then meet remaining demand from sustainable sources wherever possible.

For all developments, the submitted information should set out an approach to water management that reduces water usage and waste and priorities demand reduction measures over supply measures.

Reducing water use

Development, whether new construction or change of use and refurbishment, can save water by including measures such as:

- systems for greywater reuse
- aerated washbasin/kitchen taps and shower heads,
- tapered and low-capacity baths,
- sensor and low flush toilets, shower timers, and,
- water efficient white goods and appliances such as washing machines and dishwashers.

Water use during construction can be reduced through measures including:

- closed loop wheel washers,
- waterless wheel washing using angled steel grids to remove debris,
- high pressure low volume power hoses, recirculating water where possible,
- limiting the water used for flushing building services by stopping it as soon as the flush water turns clear, and

- employing a regime for monitoring water use and water waste.

Choosing the best location for a boiler can reduce water consumption and heat loss. By minimising the length of hot water pipes the volume of water that must be drawn off each time a tap or shower is used can be reduced. Positioning hot water pipes above pipes carrying cold water will reduce heat transfer. Further heat loss can be reduced by insulating the piping.

For all new dwellings, a completed "water efficiency calculator for new dwellings" worksheet that accords with Part G of the building regulations' Approved Documents should be provided prior to occupation. The calculation must demonstrate that the new dwellings will achieve a maximum water usage of 125 litres per person per day.

Controls and Monitoring

Advanced lighting and space conditioning controls will be incorporated, specifically:

- For areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate;
- Heating and cooling systems controls will comprise time and temperature controls, both centrally for the whole building, and locally for each space;
- Smart metering to be installed on all new dwellings for adequate monitoring;

Overheating Risk analysis

Passive solar gain refers to the process whereby a building is heated by the sun, either directly from sunlight passing through a window and heating the inside of the building, or indirectly as sunlight warms the external fabric of the building and the heat travels to the interior. The level of passive solar gain can significantly impact upon the quality of a building, how it is used and the energy needed for it to be inhabited comfortably. Passive solar gain can reduce the need for mechanical heating, which in turn reduces energy use and carbon emissions.

Key factors that influence passive solar gain include the physical characteristics of the site, immediate surroundings, orientation of buildings, external design, internal layout and the construction materials used.

Whilst passive solar gain can reduce the carbon emissions associated with heating, if used incorrectly it can lead to overheating, which in turn can lead to the installation of mechanical cooling equipment (e.g., air conditioning). Mechanical cooling increases energy consumption and requires maintenance, resulting in costs and carbon emissions. Mechanical cooling units also produce heat that requires dissipation. The need for mechanical cooling can be avoided or lessened by designing-in passive

ventilation and passive cooling measures. Developments should not incorporate mechanical cooling unless passive measures have been fully explored and appraised and proposals that include mechanical cooling should clearly demonstrate that passive measures would not be adequate.

The potential overheating for the development is to be assessed in accordance to Part O of the Building Regulation. Utilising the simplified approach is the first protocol to ensure the scheme does not over heat, where the simplified approach fails to meet the required reduction, a dynamic simulation will need to be undertaken.

The following list includes some of the key considerations in the design of new schemes:

- Rooms that are most frequently occupied should benefit from a southerly aspect, but with appropriate measures to avoid overheating.

- Orientation and layout of habitable rooms, and window size and orientation, should be carefully considered in relation to the path of the sun.

- Rooms that include a concentration of heat generating appliances (e.g., kitchens) or are less frequently occupied (e.g. bathrooms) should be located in the cooler part of the building, generally the northern side.

- Deep projections that overshadow windows should be avoided, particularly on south facing elevations. Projections should be sized appropriately so that they provide shading from the sun during the hottest part of the year but allow solar gain in the colder months.

- Where there is a chance that overheating can occur (e.g., due to large expanses of glazing on roofs and south facing elevations), design measures such as roof overhangs, brise soleil, external shuttering, photochromatic and thermochromic glass and a lighter colour palette can help.

- Zonal heating and ventilation systems and controls can be used allowing areas subject to high solar gain to occupy their own temperature control zone. Dynamic controls reduce energy waste.

- Use of materials to build in thermal mass to absorb excess heat during warmer periods and release it slowly during cooler periods (e.g., day/night, summer/winter).

- Buildings should be designed for passive ventilation:
    - cross ventilation with windows located on opposite walls and/or roof mounted turbines or wind cowls that assist with circulation of air by drawing air through windows or top floor openings and

Be Lean CO_2 emissions & savings

By means of energy efficiency measures and suitable heating systems, regulated CO_2 emissions for the property are shown to reduce by **11.73%** compared to the baseline.

Be Clean – Supply energy efficiently

There are no changes from the previous stage, however research into low carbon energy sources is still completed as a due diligence for the alternative solutions. Carbon Emissions Reduction is shown to remain at **11.73%** compared to the baseline.

Low Carbon Energy Sources

Combined Heat and Power (CHP)

The presence of a year-round base hot water generation heat load in residential units is favourable to CHP. To date, there are readily available micro gas fired CHP units (such as EC power) on the market. At this stage gas fired CHP will be provisionally incorporated into the development's LZC strategy, however, the carbon reductions due to CHP are extremely sensitive to the system design, unit selection and running time.

CHP (Combined Heat & Power) is a great technology to use, however the system itself needs to run on a 24-hour basis. The heat generated would be exceeding the demand and needs for this site, and would require to have an outlet area which can profit from this excess; however, this development does not have a space that benefit from this; therefore, this option has considered not feasible for this development.

Heat Networks

All new developments should look connect, or be connection ready, where a heat distribution network already exists. The investigation of opportunities should cover all scales and should not be limited to district heating systems.

Where such networks exist and developments should propose to connect to them, the energy statement should set out details showing how connection will occur (a connection strategy). Where such networks exist, and developments do not propose to connect to them, the energy statement must set out clear reasons as to why the connection is not feasible, or why an alternative source of energy would be more sustainable.

The development is currently located in a site where local heat networks are present, so therefore it is concluded that connection into a heat network is not feasible.

Be Green – Use renewable energy

Renewable technologies feasibility study

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were considered.

This section provides an overview of the technologies considered, a brief assessment of their feasibility, a proposed mixture of suitable technologies.

The proposed development will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance.

A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO_2 savings achieved;
- Site constraints;
- Financial benefit
- Any potential visual impacts

Demand profiles

The balance of technologies chosen will depend on the development's energy demand patterns.

Keeping in mind that the space heating energy demand changes according to the season. While hot water energy demand will provide a significant base load throughout the year.

Electrical demand is likely to be moderate throughout the year. Lighting loads will be highest during the evening but will continue at reduced levels throughout the night and during the day.

Feasibility

At this early stage in the design, it is possible only to outline the likely feasibility of specific technologies. Further descriptions of the LZC technologies below are included in Appendix A.

Table 6. Renewable and Low Zero Carbon Technologies

Renewable Technology	Comments	Lifetime (Years)	Maintenance	External Impact	Site Feasibility	Adopted for Site
BIOMASS 	Burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20	High	High	1	☐
PV 	PV panels would generate significant carbon savings, whilst having minimal impact on the appearance of the building and no adverse impact on the amenity of neighbouring buildings.	25	Low	Med	9	▣
Solar Thermal 	Solar thermal array mounted on the roof may contribute to carbon reductions, but will reduce the amount of available roof space where Photo voltaics are proposed	25	Low	Med	7	☐
Air/Ground Source Heat Pump 	Ground loops requires space, additional time at the beginning of the construction process and very high capital costs, however in terms of the air source heat pump solution is a viable and cost-effective solution to meet the required carbon reductions.	20	Med	Low	9	▣
Wind 	Due to insufficient open area for installation of a stand-alone wind turbine and planning issues this option has not considered in this development.	25	Med	High	0	☐

Detailed assessment of Photovoltaic Panels

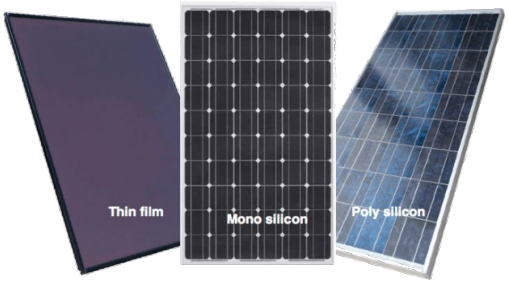


Fig 3. Photovoltaic Panels

Four types of solar cells are available on the market at present and these are mono-crystalline, polycrystalline, thin film and hybrid panels as seen in Figure 3. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

Photovoltaic Panel is considered a suitable technology as the development provides an extent of roof space for the installation of PV panels. In addition to this the PV arrays are relatively easy to install when compared to other renewable systems and provide a significant amount of CO_2 savings.

The PV shall comprise **3.50kWp** of sloped roof mounted arrays on the dwelling; Table 7 summarizes the technical data for the proposed PV array. In total, the PV installation would produce a further regulated CO_2 savings of **26.7%** for the **development**.

Table 7. Proposed PV Specifications	
Photovoltaic Panels	
Module Efficiency	15%
Panel Orientation	Southwest
Tilt	Angle of slope
Power to be installed	3.50kWp
Energy Generation	1,354kWh/yr
CO_2 savings	**363.93 kgCO_2/yr**

Be Green CO_2 emissions & savings

The incorporation of renewable technologies will further reduce CO_2 emissions of the Site by a further **29.07%** compared to the baseline.

Sustainable Urban Drainage Systems (SuDS)

SuDS offer multiple benefits – they can help to manage flood risk, improve water quality, provide opportunities for water efficiency, enhance landscape and visual quality, provide amenity value and offer opportunities for biodiversity. The design of SuDS should explore fully the potential to deliver these benefits.

SuDS limit the volume and rate of surface water entering the public sewer system. They therefore have the potential to play an important role in helping to ensure the sewerage network has the capacity to cater for population growth and is resilient to the effects of climate change.

Flood zone risk assessment for planning

The Environment Agency has developed a flood risk map for planning to identify the relative risk of flooding for proposed development planning locations. Flood zones assume that no defenses are present and so where these do exist, they are only indicative of the potential for flooding.

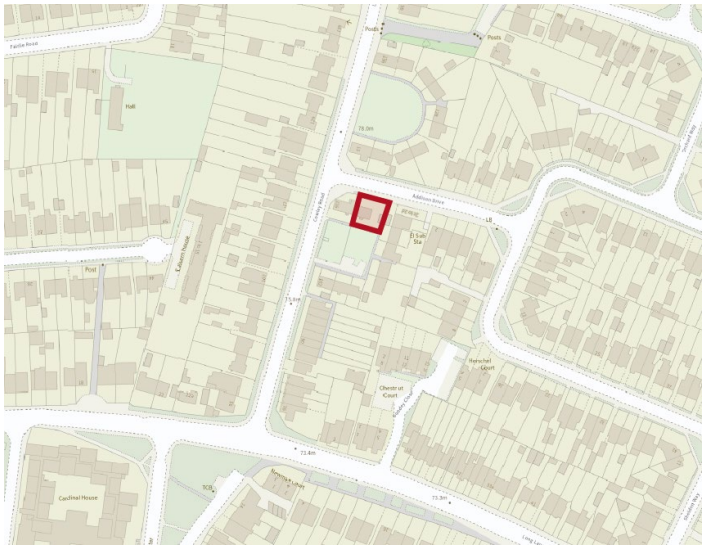


Fig 4. Environment Agency Flood Zone Interactive Map

The whole of the development lies within flood zone 1 of the Environment Agency's flood risk map as seen in fig. 4. Land located within flood zone 1 is at low risk of flooding having an associated annual probability of flooding of less than 1 in 1000 (0.1%).

Study approach

In accordance with Planning Practice Guidance for Flood Risk document, land within flood zone 1 is suitable for all uses. Assessment of this site has been based upon the Environment Agency's flood interactive map, the topographical site survey and the architect's proposed development layout.

Flood vulnerability

Based on the Environment Agencies flood map, the development site is located within Flood Zone 1 and in accordance with Planning Practice Guidance for Flood Risk neither a sequential or exception test is required.

Conclusion

Following the implementation of the three-step Energy Hierarchy, the regulated CO_2 savings for the site are calculated at 40.80%, against Part L 2021 SAP 10 performance standards.

Overall, the proposed development has been designed to meet energy policies set out by the proposed development local and national planning requirements, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

Table 8. Summarizes the implementation of the Energy Hierarchy for the proposed scheme and detail the CO_2 emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset, in addition to this a total site average is calculated, this average meets the 40% Carbon reduction over a Part L1A 2021 baseline, requirements as set by Oxford City Local Plan RE1.

Table 8. Energy and Carbon Reductions for Site Wide Reduction				
	Primary energy kWh/year	**Energy Consumption Savings (%)**	**Total CO_2 Emissions (Tonnes CO_2/Year)**	**CO_2 Emissions Savings (%)**
Baseline	7,180		1.36	
Be Lean	8,263	-15.10%	1.20	11.73%
Be Clean	8,263	00.00%	1.20	00.00%
Be Green	5,603	37.06%	0.81	29.07%
Total Reduction		**21.96%**		**40.80%**

Based on the results and outline figures, the proposed development **114 Cowley Road, Littlemore, Oxford, Oxfordshire, OX4 3TJ** will satisfy the relevant policies for sustainable design and construction requirements of energy consumption and carbon emissions.

The energy demand and carbon emissions, could be reduced by introducing a combination of energy efficiency measures and on-site renewable. Based on the calculations and results achieved when those measures were applied, the development achieved a reduction of 40.80% in CO2 emissions based on the SAP 10 Regulations.

The new development will be designed with a high level of insulation and low air permeability to reduce heat loss as much as is practically possible, also the use of low energy lighting and A – Rated White goods are essential for the reduction of energy consumption.

The control strategy throughout the proposed site must be carefully designed to ensure the most economical operation of all equipment.

To achieve the required reduction of carbon emissions, several options were considered, however the best option in regards to site location and the development size, was the installation of an Air Source Heat Pump with an MCS installation certificate within flat 1, a gas combi boiler and solar PV units on the sloped roof for flat 2.

The proposed development site is not in a close proximity of an existing heat network making this an unviable solution to improve the heating system in the dwelling at time of this application.

All buildings are to have suitable meter/smart meter management installed on every household, so that the homeowner can benefit from accurate savings to allow for suitable management of energy usage.

CHP (Combined Heat & Power) is a highly efficient technology to use for a new development, however due to the low energy demands of the development and the lack of additional space required for this technology, it will not be a preferable solution, as the site does not have the demand and space to accommodate this technology.

The baseline annual energy consumption of the site on this development have been calculated to be **1.36 Tonnes CO_2/Year** of CO2 emissions. By incorporating on-site renewable/ LZC technologies the total CO2 emissions will be reduced to **0.81 Tonnes CO_2/Year**, equivalent to 40.8% reduction over Part L 2021 requirements.

Different possible renewable energy options have been identified; bearing in mind that selection is a complex process which requires a more detailed estimation of energy demand patterns; therefore, further analysis will be undertaken as the design progresses.

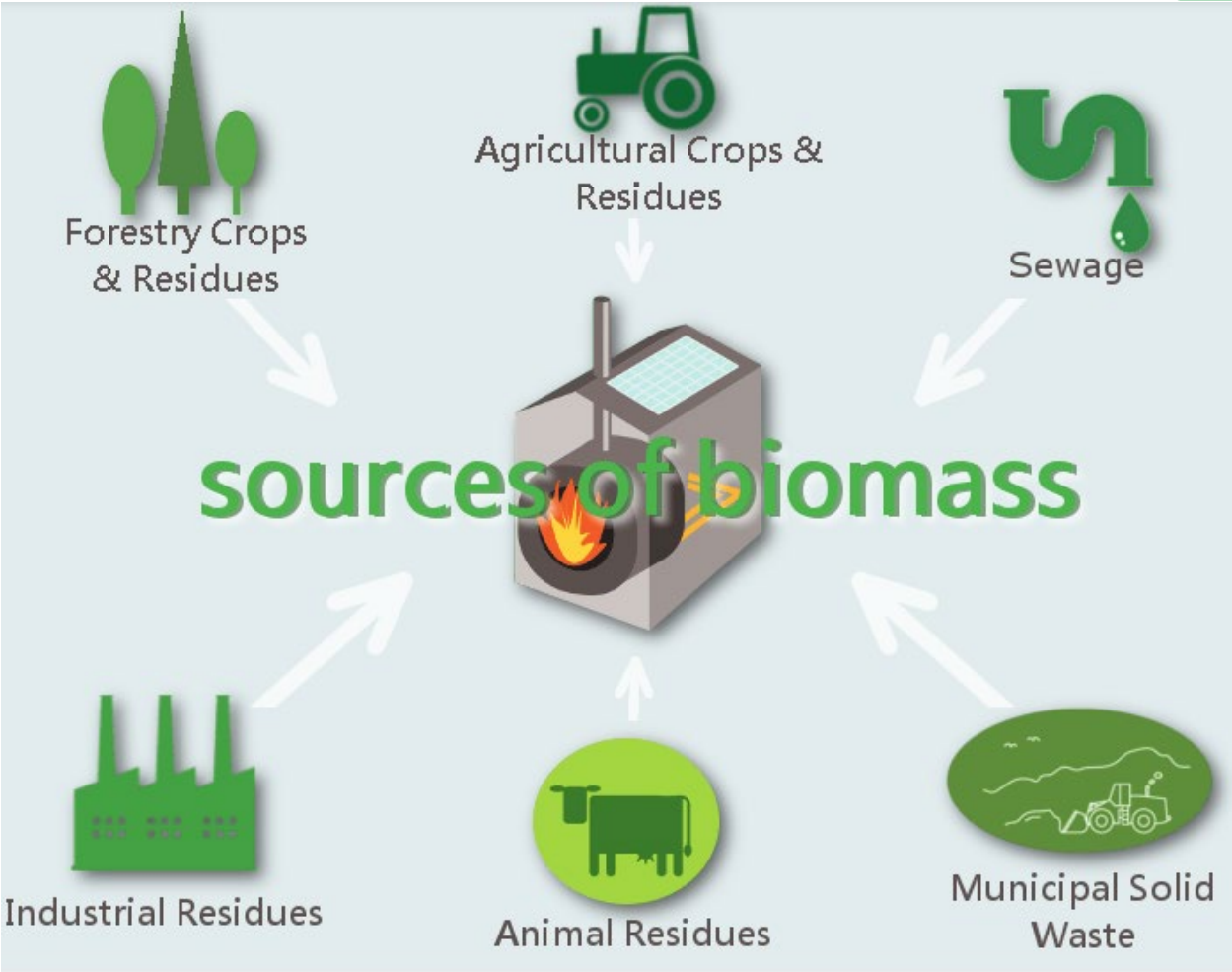
Post construction the dwelling is to have suitable testing to be provided to ensure the dwellings satisfy the requirements of this document and building regulation standards at the time of completion. This report is to be provided along with as As-Built SAP worksheets, EPC and Air testing, for all conditioned spaces in the development.

Appendix A - Low or Zero Carbon Energy Sources

Biomass As a fuel

Biomass is a renewable energy source, generated from burning wood, plants and other organic matter, such as manure or household waste. It releases CO2 when burned, but considerably less than fossil fuels. We consider biomass a renewable energy source, if the plants or other organic materials being burned are replaced.

Biomass is known for its versatility, given it can be used to generate heat, electricity, be used in combined heat and power units and be used as liquid fuel. In domestic settings, it tends to be found in the form of wood-fueled heating systems.



Geothermal Energy:

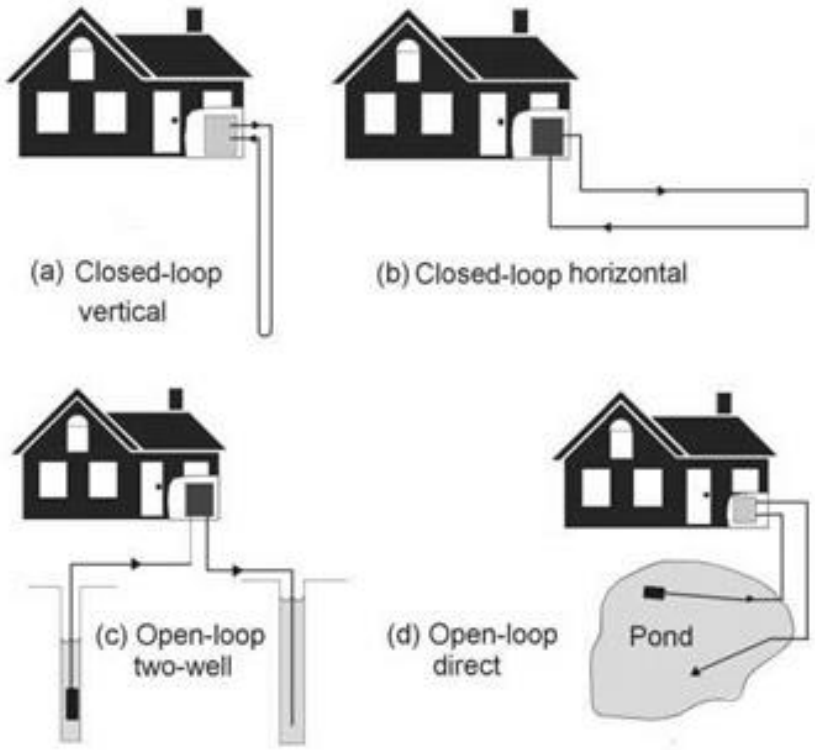
Geothermal energy technologies use the heat energy stored in ground; either for direct-use applications: such as using the grounds' heat to defrost a driveway or the indirect use with additional equipment such as a geothermal heat pump. Most commercial installations couple a heat pump with the ground to upgrade the low-grade heat from the ground or ground water to a higher-grade heat, where it can be used for heating purposes.

The suitability of a ground source system depends heavily on the type of earth coupling heat exchange system used:

Ground source earth coupling options

The right choice of appropriate heat exchanger depends on several factors such as: size of space heating/hot water system, available site area for the heat exchangers, and local ground conditions. Due to the specialist nature of this technology, we recommend that a specialist is employed to size the heat exchangers based on a desk-

top study of the site's geological conditions – this normally being required in advance of any other contractor appointment.



Vertical Closed Loop System

A frequently used and simple ground source heat exchanger, for a small to medium size project, is a closed loop vertical system. The system comprises of vertically drilled boreholes, usually up to 100 m deep, into which are inserted two polyethylene pipes with a U-shape connector at the base of the hole – effectively providing a flow down to the bottom of the hole and return back up to the surface. All the flow and return loops are connected together across the site - completing the entire heat exchange loop. Water is pumped around the loop and is then circulated around the heat pump to achieve the required heat exchange. The distance between boreholes is dependent on ground conditions but is typically a minimum of a 6mx6m grid, to prevent overlapping of the heat exchange process between loops.

Horizontal Closed Loop System

Horizontal closed loop heat exchangers are usually applied to small projects such as individual houses, which usually require a relatively low heat output. Consisting of horizontal trenches 1.5-2m deep, with either straight pipes or 'slinky' coiled pipes, these require significant excavation work and significant site area to achieve appreciable outputs as such are not normally suited to medium to large projects.

Vertical Open Boreholes System

A further option is a vertical open borehole system. The system involves the abstraction and discharge of natural ground water using boreholes; into which pumps are inserted, connected to collapsible pipework. Each borehole pump abstracts ground water, circulates it around the heat pump and then discharges the water back to the ground via an absorbing well, some distance from the original abstraction borehole. The system is capable of providing very high rates of heat exchange for a relatively small number of boreholes, which makes it very efficient in terms of site area required. However, this depends greatly on the availability of ground water, which in turn varies according to location. A major downside of this system is that the extraction of water from deep boreholes via pumps consumes a lot of energy, as the water has to be physically lifted to the surface by the pump – this in effect reduces the carbon emissions saved by this system as a whole.

Ground source heat exchange options in summary:

Vertical loop system - closed boreholes

- moderate heat capacity
- relatively low installation cost

Vertical open system - open boreholes

- high heat capacity
- high running energy
- high installation cost

Horizontal loop system – straight pipes

- low capacity,
- high installation cost
- extensive ground excavation work

Horizontal coiled loop system – 'slinky' pipes

- good capacity
- low installation cost
- extensive ground excavation work

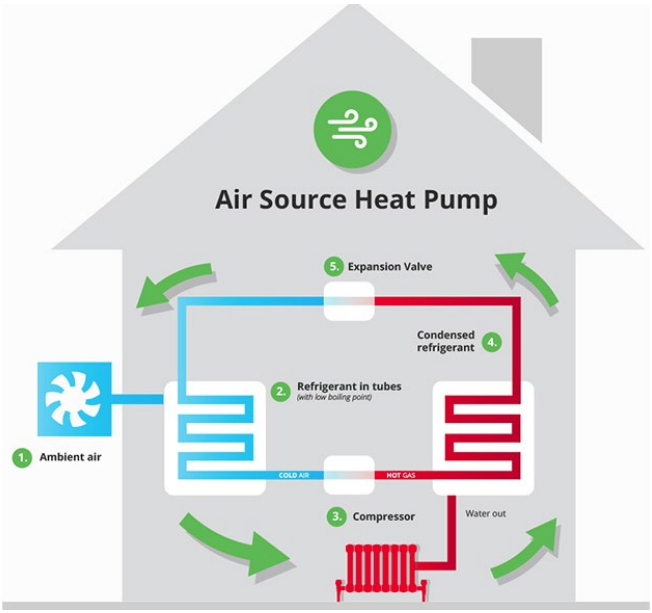
Air Source Heat Pumps

Heat pumps are basically refrigeration units which work in reverse – instead of cooling being produced and heat rejected, the unit produces heat and rejects cooling. Conventional heat pumps use air as the medium to reject this 'coolth' to atmosphere. Ground source units use the ground as a means of improving the unit efficiency because the ground is a constant 11-13 °C at depths of 50m down – this suits the heat pump much better during the coldest weather than the extremes of air temperature.

Reversible heat pumps can also be used for cooling, however this is not being considered further for this project.

A heat pump consumes electrical power to drive the compressor and other ancillary elements. The ratio between total energy input and heat energy output of the heat pump is a measure of its efficiency – usually referred to as 'Coefficient of Performance' - COP. A ground source heat pump has a higher COP than an air cooled heat pump – this additional energy effectively being the grounds' natural contribution to the system.

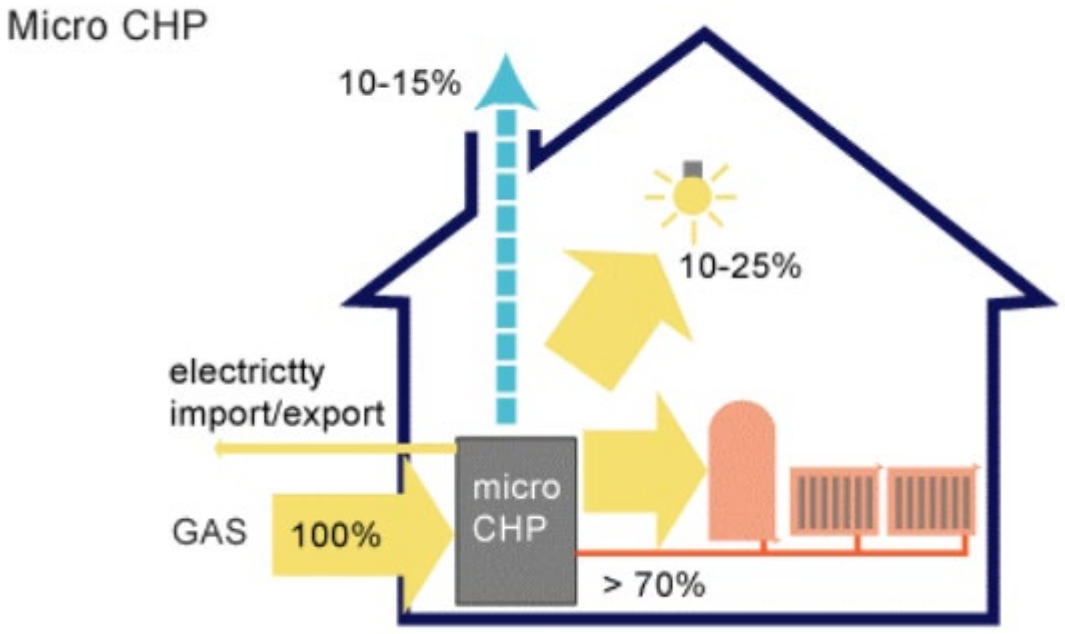
The heat produced by a heat pump is usually used to either provide space heating say to underfloor heating or radiators or the heat is used to generate domestic hot water via a storage vessel.



CHP

Combined heat and power (CHP) is a process involving simultaneous generation of heat and electricity, where the heat generated in the process in harnessed via heat recovery equipment. CHP at the large commercial size is now fairly common in premises which have a simultaneous demand for heating and electricity for long periods, such as hospitals, recreational centres and hotels. In addition, small CHP systems are now becoming available for individual houses, group residential units and small non-domestic premises. Compared with using centrally generated electricity supplied via the grid, CHP can offer a more efficient and economic method of supplying energy demand, if installed and operated appropriately, owing to the utilization of heat which is normally rejected to the atmosphere from central generating stations, and by reducing network distribution losses due to local generation and use.

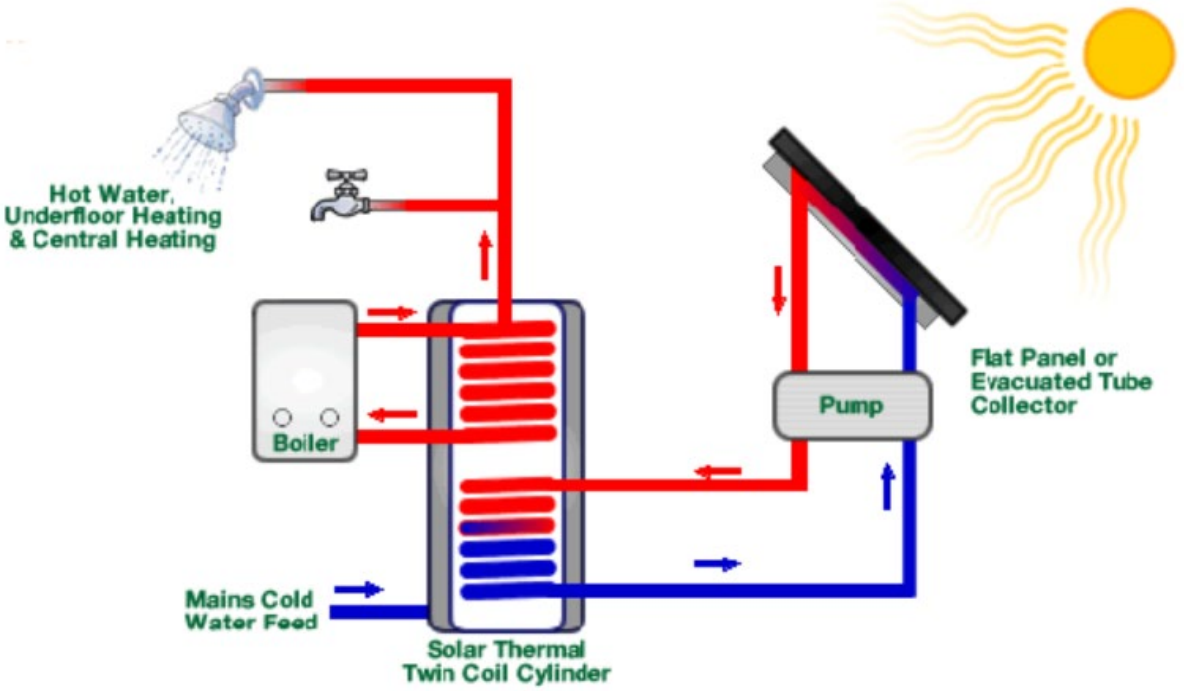
Heat generated will be used for space and water heating, and additional heat storage may be used to lengthen use periods, to assist in warm-up and to improve overall energy efficiency. For overall good energy efficiency, as with all CHP, usage must be heat demand led. Thus, a sophisticated control system is required and users should be made aware of efficient operating practices.



Solar thermal collectors

Solar thermal collectors (flat plate or evacuated tubes) convert solar thermal energy into heat for hot water generation. These are usually located on a roof oriented south

facing in an ideal slope of 45 degree. Solar collectors properly sized and designed provide approx 50% of annual hot water demand.



Photovoltaic

Photovoltaic modules convert sunlight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and fl at roofs, in façades, atria and shading devices. Modules can be mounted using frames or they can be fully incorporated into the actual building fabric; for example, PV roof tiles are now available which can be fitted in place of standard tiles.

Currently, a PV system will cost between £1500 and £2500 per kWp, and frequently part of this cost can be offset owing to the displacement of a conventional cladding material. Costs have fallen significantly since the first systems were installed (1980s) and are predicted to fall further still.

While single crystal silicon remains the most efficient flat plate technology (15–16% conversion efficiency); it also has the least potential for cost reduction. PV cells made from poly-crystalline silicon have become popular as they are less expensive to produce, although they have a slightly lower efficiency.

Thin film modules are constructed by depositing extremely thin layers of photosensitive materials on a low-cost backing such as glass, stainless steel or plastic. As much less semiconductor material is required as for crystalline silicon cells, material costs are potentially much lower. Efficiencies are much lower, around 4–5%, although this can be boosted to 8–10% by depositing two or three layers of thin film material. Thin film production also requires less handling as the films are produced as large, complete modules and not as individual cells that have to be mounted in frames and wired together. Hence, there is the potential for significant cost reductions with volume production.

Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form. The cost of the inverter and these 'Balance of System' (BOS) components can approach 30% of the total cost of a PV system. Hence, simplification and cost reductions in these components over the coming years will also be necessary to make PV systems affordable.

Wind energy

Wind power is the most successful and fastest spreading renewable energy technology in the UK with a number of individual and group installations of varying size, capacity and location. Traditionally, turbines are installed in non-urban areas with a strong trend for large offshore wind farms. In parallel with the design and development of ever-bigger machines, which are deemed to be more efficient and cost-effective, it is being increasingly recognized that smaller devices installed at the point of use, i.e. urban settings, can play an important role in reducing carbon emissions if they become mainstream.

At present there is a wide range of available off-the-shelf wind products, many manufactured in the UK and EU with proven good performance and durability. The dominant type is horizontal axis wind turbines (HAWT), which are typically ground mounted. Vertical axis wind turbines (VAWT) have limited market presence and there is a trade-off between lower efficiency and potentially higher resistance to extreme conditions. Capacity ranges from 500W to more than 1.5MW, but, for practical purposes and in built-up areas in particular, machines of more than 1kW and below 500kW are likely to be considered.
Wind technology is also currently one of the most cost-effective renewable energy technologies, which is attributable to the large scale of installations reducing the unit output cost. Individual building or community wind projects, although smaller, have the advantage of feeding electricity directly into the building's electricity circuit, thus sparing costly distribution network development and avoiding distribution losses. The downside is the still high capital cost per kW installed for smaller turbines, plus location constraints, such as visual intrusion and noise. The wind regime in urban areas is also a concern owing to higher wind turbulence which reduces the potential electricity output.

In most cases, wind turbines are connected to the electricity grid and all generated energy is used regardless of the building demand fluctuations. The output largely depends on the wind speed and the correlation between the two is a cube function. This means that in short periods of above-average wind speeds the generation increases exponentially. As a result, it is difficult to make precise calculations of the annual output of a turbine, but average figures can provide useful guidance to designers and architects. In reasonably windy areas (average wind speed of 6m/s) the expected output from 1kW installed is about 2500kWh annually.

The cost per kW installed varies considerably by manufacturer and size of machine with an indicative bracket of £2,500–£5,000. With a lifespan of more than 20 years, wind turbines can save money if design and planning are carried out in a robust way.

Building-integrated wind turbines are starting to be a reality in the UK, but potential projects may face difficulties with obtaining planning permission. There are a few examples now of permitted development rights for certain rooftop turbines in some local councils. A number of horizontal axis devices specifically designed for building integration are now available commercially, having design and reliability parameters relevant to the urban context. Building-mounted vertical axis devices are under development. At present, turbines installed near buildings, as well as community installations for groups of buildings, should be regarded as the larger wind energy source related to buildings, when they contribute to the carbon emissions from these premises using 'private wire' networks. However, the contribution of several building-

integrated turbines in a development is likely to become significant in the next few years.

Appendix B-Fuel prices and emission factors

	Standing	Unit Price	Emission Kg CO2	PE Fuel	
Gas fuels:	**Charge £**	**p/kWh**	**p/kWh**	**Factor**	**Code**
mains gas	92	3.64	0.210	1.130	1
bulk LPG	62	6.74	0.241	1.141	2
bottled LPG (for main heating system)		9.46	0.241	1.141	3
bottled LPG (for secondary heating)		11.20	0.241	1.133	5
LPG subject to Special Condition 11F (a)	92	3.64	0.241	1.163	9
biogas (including anaerobic digestion)	62	6.74	0.024	1.286	7
Liquid fuels:					
heating oil		4.94	0.298	1.180	4
bio-liquid HVO from used cooking oil (d)		6.79	0.036	1.180	71
bio-liquid FAME from animal/vegetable oils (e)		6.79	0.018	1.180	73
B30K (0		5.49	0.214	1.136	75
bioethanol from any biomass source		47	0.105	1.472	76
Solid fuels: (g)					
house coal		5.58	0.395	1.064	11
anthracite		4.19	0.395	1.064	15
manufactured smokeless fuel		5.91	0.366	1.261	12
wood logs		5.12	0.028	1.046	20
wood pellets (in bags for secondary heating)		6.91	0.053	1.325	22
wood pellets (bulk supply for main heating)		6.25	0.053	1.325	23
wood chips		3.72	0.023	1.046	21
dual fuel appliance (mineral and wood)		4.77	0.087	1.049	10
Electricity: (a)					
standard tariff	81 30	16.49	0.136 (s)	1.5010t)	
7-hour tariff (high rate) (h)	7 32	19.60	0.136 (s)	1.5010t)	
7-hour tariff (low rate) (h)		9.40 31	0.136 (s)	1.501 (t)	
10-hour tariff (high rate) (''>	21 34	20.54	0.136 (s)	1.501 (t)	
10-hour tariff (low rate) fib)		12.27 33	0.136 (a)	1.501 (0	
18-hour tariff (high rate) (''>	26 38	17.41	0.136 (s)	1.501 (0	
18-hour tariff (low rate) 00		14.17 40	0.136 (s)	1.501 (t)	
24-hour heating tariff	26 35	14.04	0.136 (s)	1.501 0)	
electricity sold to grid, PV		5.59 (0 60	0.136 (s)	0.501 0)	
electricity sold to grid, other		5.59 () 36	0.136 (s)	0.501 0)	
electricity, any tariff 0)		N/A 39	0.136 (s)	1.501 0t)	
Heat networks: (k)	92 0)				
heat from boilers - mains gas		4.44 51	0.210	1.130	
heat from boilers - LPG		4.44 52	0.241	1.141	
heat from boilers - oil (assumes 'gas oil')		4.44 53	0.335	1.180	
heat from boilers that can use mineral oil or biodiesel		4.44 56	0.335	1.180	
heat from boilers using HVO from used cooking oil		4.44	0.036	1.180	

	57		
heat from boilers FAME from animal/vegetable oils (a)	4.44	0.018	1.180
	58		
heat from boilers - B30D 0)	4.44	0.269	1.090
	55		
heat from boilers - coal	4.44	0.375	1.064
	54		
heat from electric heat pump	4.44	0.136 (s)	1.501 0)
	41		
heat recovered from waste combustion	4.44	0.015 0')	0.063
	42		
heat from boilers - biomass	4.44	0.029	1.037
	43		
heat from boilers - biogas (landfill or sewage gas)	4.44	0.024	1.286
	44		
heat recovered from power station	3.77	0.015 0')	0.063
	45		
high grade heat recovered from process (Appendix C4.3)	3.77	0.011	0.051
	47		
low grade heat recovered from process (Appendix C4.4)	3.77	0.136 001)	1.501 (001)
	49		
heat recovered from geothermal or other natural processes	3.77	0.011	0.051
	46		
heat from **CHP**	3.77	as above0D	as above0D
	48		

Appendix C, D, E, F and G

This appendix contains the following reports used in producing the content of this Energy and Sustainability Statement.

Appendix C- Flood risk map for planning to show the location of the site with regards to the relevant flood zone areas.

Appendix D- SAP calculation reports for the selected units that were used to base the calculations on for this report. (All hierarchy steps)

Appendix E- Block compliance report showing the overall 40% reduction

Appendix F- Floor Plans and Elevations used for the SAP Calculations

Appendix G- Sample water calculations

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**454051/203360**	**27 Sep 2023 14:06**

Your selected location is in flood zone 1, an area with a low probability of flooding.

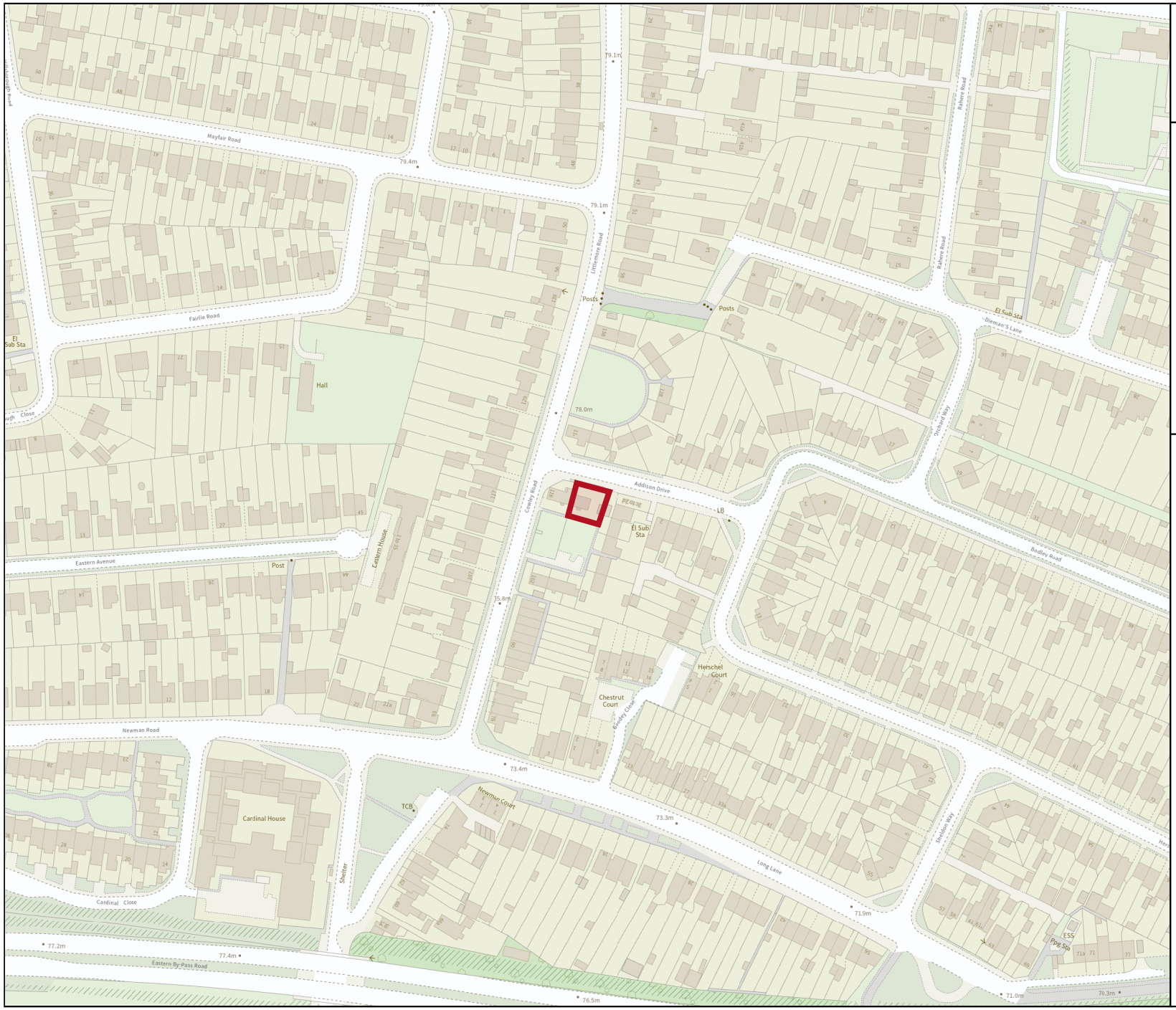
You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
454051/203360

Scale
1:2500

Created
27 Sep 2023 14:06

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

Full SAP Calculation Printout

Property Reference	PR10986 - Flat 1	Issued on Date	27/09/2023
Assessment Reference	001 - Be Green	Prop Type Ref	
Property	114, Cowley Road, Oxford, Oxfordshire, OX4 3TJ		

SAP Rating	81 B	DER	6.00	TER	15.63
Environmental	96 A	% DER < TER			61.61
CO_2 Emissions (t/year)	0.23	DFEE	33.28	TFEE	39.61
Compliance Check	See BREL	% DFEE < TFEE			15.98
% DPER < TPER	23.49	DPER	63.63	TPER	83.16

Assessor Details	Mr. Iraj Maghounaki	Assessor ID	V571-0001
Client			

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.4600 (1b)	x	2.4200 (2b)	=	102.7532 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	42.4600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	102.7532	(5)

---

2. Ventilation rate

---

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1946	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4446	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3446	(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	0.4394	0.4307	0.4221	0.3791	0.3704	0.3274	0.3274	0.3188	0.3446	0.3704	0.3877	0.4049	(22b)
Effective ac	0.5965	0.5928	0.5891	0.5718	0.5686	0.5536	0.5536	0.5508	0.5594	0.5686	0.5751	0.5820	(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	
Solid Door			1.9100	1.2000	2.2920			(26)
Windows (Uw = 1.20)			5.3900	1.1450	6.1718			(27)
Heat Loss Floor			42.4600	0.1200	5.0952	110.0000	4670.6000	(28a)
External Walls	62.1500	7.3000	54.8500	0.1800	9.8730	110.0000	6033.5000	(29a)
Plane Roof	3.8800		3.8800	0.1000	0.3880	9.0000	34.9200	(30)
Total net area of external elements Aum(A, m2)			108.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.8200			(33)
Party Wall			17.6400	0.0000	0.0000	110.0000	1940.4000	(32)

Party Ceiling	38.4900	20.0000	769.8000 (32b)
Timber	62.6800	9.0000	564.1200 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 14013.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 330.0363 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	5.7000	0.0190	0.1083
E3 Sill	4.7900	0.0220	0.1054
E4 Jamb	11.0000	0.0170	0.1870
E5 Ground floor (normal)	20.8400	0.0580	1.2087
E10 Eaves (insulation at ceiling level)	1.7200	0.0570	0.0980
E12 Gable (insulation at ceiling level)	2.2600	0.0430	0.0972
E16 Corner (normal)	7.2600	0.0420	0.3049
E17 Corner (inverted – internal area greater than external area)	2.4200	-0.0900	-0.2178
E18 Party wall between dwellings	14.5200	0.0330	0.4792
P1 Party wall - Ground floor	12.1300	0.0430	0.5216

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 2.8925 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 26.7124 (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	20.2271	20.1000	19.9754	19.3903	19.2809	18.7713	18.7713	18.6769	18.9675	19.2809	19.5023	19.7338	(38)
Heat transfer coeff	46.9395	46.8125	46.6879	46.1028	45.9933	45.4837	45.4837	45.3893	45.6800	45.9933	46.2148	46.4463	(39)

Average = Sum(39)m / 12 = 46.1023

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1055	1.1025	1.0996	1.0858	1.0832	1.0712	1.0712	1.0690	1.0758	1.0832	1.0884	1.0939	(40)
HLP (average)												1.0858	
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 1.4731 (42)
Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

29.7165	28.6359	27.5553	26.4747	25.3941	24.3135	24.3135	25.3941	26.4747	27.5553	28.6359	29.7165	(42c)

Average daily hot water use (litres/day) 27.0150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	29.7165	28.6359	27.5553	26.4747	25.3941	24.3135	24.3135	25.3941	26.4747	27.5553	28.6359	29.7165	(44)
Energy conte	47.0637	40.7771	42.3515	36.2425	34.1853	29.8963	29.4051	31.4432	32.6459	37.3923	40.7971	46.5288	(45)

Energy content (annual) Total = Sum(45)m = 448.7288
Distribution loss (46)m = 0.15 x (45)m

7.0595	6.1166	6.3527	5.4364	5.1278	4.4844	4.4108	4.7165	4.8969	5.6088	6.1196	6.9793	(46)

Water storage loss:
Store volume 170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8802 (55)
Total storage loss

27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)

If cylinder contains dedicated solar storage

27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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

97.6123	86.4339	92.9001	85.1605	84.7339	78.8143	79.9537	81.9918	81.5639	87.9409	89.7151	97.0774	(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

97.6123	86.4339	92.9001	85.1605	84.7339	78.8143	79.9537	81.9918	81.5639	87.9409	89.7151	97.0774	(64)

Total per year (kWh/year) = Sum(64)m = 1043.8978 (64)
12Total per year (kWh/year) 1044 (64)
Electric shower(s)

50.2616	44.7835	48.9019	46.6665	47.5422	45.3506	46.8623	47.5422	46.6665	48.9019	47.9824	50.2616	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 571.7232 (64a)
Heat gains from water heating, kWh/month

68.6530	61.2797	66.7462	62.8517	63.6910	60.4126	61.9316	62.7793	61.6558	65.0973	64.6950	68.4751	(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	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	(66)

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

68.6062	75.9569	68.6062	70.8931	68.6062	70.8931	68.6062	68.6062	70.8931	68.6062	70.8931	68.6062	(67)

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

127.7663	129.0921	125.7511	118.6385	109.6601	101.2217	95.5843	94.2585	97.5995	104.7121	113.6905	122.1289	(68)

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

	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)												
	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	(71)
Water heating gains (Table 5)												
	92.2755	91.1901	89.7127	87.2940	85.6062	83.9063	83.2414	84.3808	85.6331	87.4964	89.8542	92.0365 (72)
Total internal gains												
	336.7452	344.3363	332.1672	324.9228	311.9698	301.1183	292.5291	292.3426	299.2228	308.9119	322.5350	330.8688 (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	1.8000	11.2829	0.6300	0.8000	0.7700	7.0935	(75)
Southwest	3.5900	36.7938	0.6300	0.8000	0.7700	46.1353	(79)

Solar gains	53.2288	93.0244	133.5385	175.9507	206.6542	209.3714	200.1037	176.5536	148.1248	104.4992	64.1849	45.2751 (83)
Total gains	389.9740	437.3607	465.7057	500.8734	518.6240	510.4897	492.6329	468.8962	447.3476	413.4111	386.7198	376.1439 (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	82.9278	83.1530	83.3748	84.4330	84.6339	85.5822	85.5822	85.7601	85.2144	84.6339	84.2284	83.8085	
alpha	6.5285	6.5435	6.5583	6.6289	6.6423	6.7055	6.7055	6.7173	6.6810	6.6423	6.6152	6.5872	
util living area													
	0.9947	0.9879	0.9715	0.9108	0.7726	0.5645	0.4057	0.4442	0.6831	0.9233	0.9858	0.9957	(86)
MIT	20.1970	20.3475	20.5442	20.7932	20.9450	20.9940	20.9994	20.9990	20.9804	20.8035	20.4691	20.1758	(87)
Th 2	19.9963	19.9988	20.0012	20.0125	20.0146	20.0244	20.0244	20.0262	20.0206	20.0146	20.0103	20.0058	(88)
util rest of house													
	0.9925	0.9831	0.9601	0.8785	0.7090	0.4814	0.3161	0.3508	0.5961	0.8884	0.9793	0.9940	(89)
MIT 2	19.0863	19.2780	19.5240	19.8238	19.9762	20.0219	20.0243	20.0260	20.0107	19.8429	19.4417	19.0669	(90)
Living area fraction										fLA = Living area / (4) =		0.4366	(91)
MIT	19.5713	19.7450	19.9695	20.2471	20.3992	20.4464	20.4501	20.4508	20.4341	20.2623	19.8903	19.5511	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5713	19.7450	19.9695	20.2471	20.3992	20.4464	20.4501	20.4508	20.4341	20.2623	19.8903	19.5511	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9913	0.9815	0.9596	0.8870	0.7350	0.5177	0.3552	0.3917	0.6339	0.8984	0.9783	0.9929	(94)
Useful gains	386.5977	429.2830	446.9117	444.2857	381.1812	264.2966	175.0059	183.6571	283.5784	371.3888	378.3112	373.4917	(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													
	716.8283	694.9320	628.8612	523.1332	400.1045	265.9137	175.1158	183.8648	289.3427	444.4030	591.1026	713.0003	(97)
Space heating kWh													
	245.6915	178.5161	135.3705	56.7702	14.0790	0.0000	0.0000	0.0000	0.0000	54.3225	153.2098	252.5944	(98a)
Space heating requirement - total per year (kWh/year)												1090.5540	
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													
	245.6915	178.5161	135.3705	56.7702	14.0790	0.0000	0.0000	0.0000	0.0000	54.3225	153.2098	252.5944	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1090.5540	
Space heating per m2											(98c) / (4) =	25.6843	(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 %)	219.3000 (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													
	245.6915	178.5161	135.3705	56.7702	14.0790	0.0000	0.0000	0.0000	0.0000	54.3225	153.2098	252.5944	(98)
Space heating efficiency (main heating system 1)													
	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)													
	112.0344	81.4027	61.7284	25.8870	6.4200	0.0000	0.0000	0.0000	0.0000	24.7709	69.8631	115.1821	(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

	97.6123	86.4339	92.9001	85.1605	84.7339	78.8143	79.9537	81.9918	81.5639	87.9409	89.7151	97.0774 (64)

Efficiency of water heater 190.4000 (216)

(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (217)

Fuel for water heating, kWh/month

	51.2669	45.3960	48.7920	44.7272	44.5031	41.3941	41.9925	43.0629	42.8382	46.1874	47.1193	50.9861 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	17.5999	14.1193	12.7129	9.3140	7.1944	5.8779	6.5630	8.5308	11.0807	14.5384	16.4211	18.0891 (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	497.2887 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	190.4000
Water heating fuel used	548.2656 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	142.0415 (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	1759.3190 (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	497.2887	0.1568	77.9726 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	548.2656	0.1400	76.7404 (264)
Energy for instantaneous electric shower(s)	571.7232	0.1391	79.5393 (264a)
Space and water heating			154.7131 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	142.0415	0.1443	20.5010 (268)
Total CO2, kg/year			254.7534 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			6.0000 (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	497.2887	1.5805	785.9517 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	548.2656	1.5175	831.9980 (278)
Energy for instantaneous electric shower(s)	571.7232	1.5143	865.7799 (278a)
Space and water heating			1617.9498 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	142.0415	1.5338	217.8680 (282)
Total Primary energy kWh/year			2701.5977 (286)
Dwelling Primary energy Rate (DPER)			63.6300 (287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.4600 (1b)	x	2.4200 (2b)	=	102.7532 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 42.4600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	102.7532	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1946	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4446	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3446	(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	0.4394	0.4307	0.4221	0.3791	0.3704	0.3274	0.3274	0.3188	0.3446	0.3704	0.3877	0.4049	(22b)
Effective ac	0.5965	0.5928	0.5891	0.5718	0.5686	0.5536	0.5536	0.5508	0.5594	0.5686	0.5751	0.5820	(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 Opaque door			1.9100	1.0000	1.9100			(26)
TER Opening Type (Uw = 1.20)			5.3900	1.1450	6.1718			(27)
Heat Loss Floor			42.4600	0.1300	5.5198			(28a)
External Walls	62.1500	7.3000	54.8500	0.1800	9.8730			(29a)
Plane Roof	3.8800		3.8800	0.1100	0.4268			(30)
Total net area of external elements Aum(A, m2)			108.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.9014			(33)
Party Wall			17.6400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 339.1013 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	5.7000	0.0500	0.2850
E3 Sill	4.7900	0.0500	0.2395
E4 Jamb	11.0000	0.0500	0.5500
E5 Ground floor (normal)	20.8400	0.1600	3.3344
E10 Eaves (insulation at ceiling level)	1.7200	0.0600	0.1032
E12 Gable (insulation at ceiling level)	2.2600	0.0600	0.1356
E16 Corner (normal)	7.2600	0.0900	0.6534
E17 Corner (inverted – internal area greater than external area)	2.4200	-0.0900	-0.2178
E18 Party wall between dwellings	14.5200	0.0600	0.8712
P1 Party wall - Ground floor	12.1300	0.0800	0.9704

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.9249 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	30.8263 (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	20.2271	20.1000	19.9754	19.3903	19.2809	18.7713	18.7713	18.6769	18.9675	19.2809	19.5023	19.7338	(38)
Heat transfer coeff	51.0534	50.9263	50.8017	50.2166	50.1071	49.5975	49.5975	49.5031	49.7938	50.1071	50.3286	50.5601	(39)
Average = Sum(39)m / 12 =												50.2161	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2024	1.1994	1.1965	1.1827	1.1801	1.1681	1.1681	1.1659	1.1727	1.1801	1.1853	1.1908	(40)
HLP (average)												1.1827	
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												1.4731 (42)
Hot water usage for mixer showers												
	62.7617	61.8185	60.4441	57.8144	55.8738	53.7096	52.4795	53.8435	55.3387	57.6623	60.3485	62.5212 (42a)
Hot water usage for baths												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42b)
Hot water usage for other uses												
	29.7165	28.6359	27.5553	26.4747	25.3941	24.3135	24.3135	25.3941	26.4747	27.5553	28.6359	29.7165 (42c)
Average daily hot water use (litres/day)												84.8791 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	92.4782	90.4544	87.9994	84.2891	81.2678	78.0231	76.7929	79.2376	81.8134	85.2176	88.9844	92.2377	(44)
Energy conte	146.4628	128.8058	135.2517	115.3875	109.4021	95.9385	92.8744	98.1126	100.8840	115.6395	126.7746	144.4219	(45)
Energy content (annual)										Total = Sum(45)m =		1409.9557	
Distribution loss (46)m = 0.15 x (45)m													
	21.9694	19.3209	20.2878	17.3081	16.4103	14.3908	13.9312	14.7169	15.1326	17.3459	19.0162	21.6633	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(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													
	194.8405	172.5018	183.6294	162.2047	157.7798	142.7556	141.2521	146.4903	147.7012	164.0172	173.5917	192.7996	(62)
WWHRS	-28.6920	-25.3755	-26.5717	-22.0024	-20.5055	-17.5467	-16.4472	-17.4900	-18.1545	-21.4021	-24.2460	-28.1607	(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													
	166.1485	147.1264	157.0577	140.2023	137.2744	125.2089	124.8049	129.0004	129.5467	142.6151	149.3457	164.6390	(64)
										Total per year (kWh/year) = Sum(64)m =		1712.9699	(64)
12Total per year (kWh/year)												1713	(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													
	87.4010	77.7847	83.6734	75.8201	75.0784	69.3532	69.5829	71.3246	70.9977	77.1523	79.6063	86.7225	(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	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	70.6432	78.2122	70.6432	72.9980	70.6432	72.9980	70.6432	70.6432	72.9980	70.6432	72.9980	70.6432	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	127.7663	129.0921	125.7511	118.6385	109.6601	101.2217	95.5843	94.2585	97.5995	104.7121	113.6905	122.1289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	(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)													
	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	(71)
Water heating gains (Table 5)													
	117.4745	115.7511	112.4642	105.3056	100.9118	96.3240	93.5254	95.8664	98.6078	103.6993	110.5642	116.5624	(72)
Total internal gains													
	363.9813	371.1526	356.9557	345.0394	329.3123	315.6408	304.8501	305.8653	314.3025	327.1519	345.3499	357.4318	(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	1.8000	11.2829	0.6300	0.7000	0.7700	6.2068	(75)
Southwest	3.5900	36.7938	0.6300	0.7000	0.7700	40.3684	(79)

Solar gains	46.5752	81.3964	116.8462	153.9568	180.8224	183.2000	175.0907	154.4844	129.6092	91.4368	56.1618	39.6157	(83)
Total gains	410.5564	452.5489	473.8019	498.9962	510.1348	498.8408	479.9409	460.3497	443.9117	418.5887	401.5117	397.0475	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	78.3398	78.5353	78.7279	79.6452	79.8192	80.6394	80.6394	80.7931	80.3215	79.8192	79.4680	79.1041	
alpha	6.2227	6.2357	6.2485	6.3097	6.3213	6.3760	6.3760	6.3862	6.3548	6.3213	6.2979	6.2736	
util living area	0.9945	0.9888	0.9764	0.9324	0.8214	0.6229	0.4531	0.4918	0.7335	0.9383	0.9869	0.9955	(86)
MIT	20.1313	20.2716	20.4638	20.7209	20.9079	20.9868	20.9985	20.9975	20.9647	20.7483	20.4055	20.1106	(87)
Th 2	19.9181	19.9205	19.9228	19.9339	19.9360	19.9456	19.9456	19.9474	19.9419	19.9360	19.9318	19.9274	(88)
util rest of house	0.9921	0.9842	0.9662	0.9040	0.7576	0.5270	0.3455	0.3810	0.6392	0.9064	0.9804	0.9935	(89)
MIT 2	18.9396	19.1185	19.3601	19.6748	19.8700	19.9400	19.9453	19.9468	19.9239	19.7135	19.2976	18.9205	(90)
Living area fraction										fLA = Living area / (4) =		0.4366	(91)
MIT	19.4600	19.6220	19.8421	20.1316	20.3232	20.3971	20.4052	20.4056	20.3783	20.1654	19.7814	19.4401	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4600	19.6220	19.8421	20.1316	20.3232	20.3971	20.4052	20.4056	20.3783	20.1654	19.7814	19.4401	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9908	0.9825	0.9653	0.9100	0.7825	0.5690	0.3926	0.4296	0.6800	0.9145	0.9793	0.9924	(94)
Useful gains	406.7883	444.6409	457.3534	454.0950	399.1899	283.8274	188.4277	197.7668	301.8447	382.7790	393.1881	394.0183	(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	773.9666	749.7343	677.7989	564.0102	432.0844	287.5210	188.7261	198.2885	312.6227	479.2925	638.2363	770.5429	(97)
Space heating kWh	273.1807	205.0227	164.0114	79.1390	24.4735	0.0000	0.0000	0.0000	0.0000	71.8061	176.4347	280.1343	(98a)
Space heating requirement - total per year (kWh/year)												1274.2023	
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	273.1807	205.0227	164.0114	79.1390	24.4735	0.0000	0.0000	0.0000	0.0000	71.8061	176.4347	280.1343	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1274.2023	
Space heating per m2											(98c) / (4) =	30.0095	(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	273.1807	205.0227	164.0114	79.1390	24.4735	0.0000	0.0000	0.0000	0.0000	71.8061	176.4347	280.1343	(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)	295.9704	222.1265	177.6939	85.7410	26.5152	0.0000	0.0000	0.0000	0.0000	77.7964	191.1535	303.5041	(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	166.1485	147.1264	157.0577	140.2023	137.2744	125.2089	124.8049	129.0004	129.5467	142.6151	149.3457	164.6390	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.1674	84.8040	84.1571	82.8289	81.0428	79.8000	79.8000	79.8000	79.8000	82.6036	84.4346	85.2414	(217)
Fuel for water heating, kWh/month	195.0846	173.4898	186.6245	169.2674	169.3850	156.9034	156.3971	161.6546	162.3392	172.6499	176.8775	193.1444	(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	14.6783	11.7755	10.6025	7.7678	6.0001	4.9021	5.4735	7.1147	9.2412	12.1250	13.6952	15.0862	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-14.7321	-21.5914	-32.2600	-37.7717	-42.0707	-39.8011	-39.3611	-36.5224	-31.6979	-25.3987	-16.5023	-12.6460	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.9912	-12.8160	-25.8591	-39.3927	-52.6058	-53.0070	-52.3368	-44.0353	-31.9437	-18.4579	-8.0446	-4.7185	(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												1380.5009	(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		2073.8175 (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)		118.4621 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-699.5640 (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		2959.2165 (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	1380.5009	0.2100	289.9052	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2073.8175	0.2100	435.5017	(264)
Space and water heating			725.4069	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	118.4621	0.1443	17.0977	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-350.3554	0.1337	-46.8567	
PV Unit electricity exported	-349.2085	0.1255	-43.8270	
Total			-90.6836	(269)
Total CO2, kg/year			663.7502	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.6300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1380.5009	1.1300	1559.9660	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2073.8175	1.1300	2343.4138	(278)
Space and water heating			3903.3798	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	118.4621	1.5338	181.7011	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-350.3554	1.4942	-523.5128	
PV Unit electricity exported	-349.2085	0.4607	-160.8693	
Total			-684.3821	(283)
Total Primary energy kWh/year			3530.7996	(286)
Target Primary Energy Rate (TPER)			83.1600	(287)

Full SAP Calculation Printout

Property Reference	PR10986 - Flat 1	Issued on Date	27/09/2023
Assessment Reference	002 - Be Lean	Prop Type Ref	
Property	114, Cowley Road, Oxford, Oxfordshire, OX4 3TJ		

SAP Rating	79 C	DER	6.77	TER	15.63
Environmental	96 A	% DER < TER			56.69
CO_2 Emissions (t/year)	0.26	DFEE	33.28	TFEE	39.61
Compliance Check	See BREL	% DFEE < TFEE			15.98
% DPER < TPER	14.06	DPER	71.47	TPER	83.16

Assessor Details	Mr. Iraj Maghounaki	Assessor ID	V571-0001
Client			

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		42.4600 (1b)	x	2.4200 (2b)	=	102.7532 (1b)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	42.4600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	102.7532	(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	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1946	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4446	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3446	(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	0.4394	0.4307	0.4221	0.3791	0.3704	0.3274	0.3274	0.3188	0.3446	0.3704	0.3877	0.4049	(22b)
Effective ac	0.5965	0.5928	0.5891	0.5718	0.5686	0.5536	0.5536	0.5508	0.5594	0.5686	0.5751	0.5820	(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	
Solid Door			1.9100	1.2000	2.2920			(26)
Windows (Uw = 1.20)			5.3900	1.1450	6.1718			(27)
Heat Loss Floor			42.4600	0.1200	5.0952	110.0000	4670.6000	(28a)
External Walls	62.1500	7.3000	54.8500	0.1800	9.8730	110.0000	6033.5000	(29a)
Plane Roof	3.8800		3.8800	0.1000	0.3880	9.0000	34.9200	(30)
Total net area of external elements Aum(A, m2)			108.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.8200			(33)
Party Wall			17.6400	0.0000	0.0000	110.0000	1940.4000	(32)

Party Ceiling	38.4900	20.0000	769.8000 (32b)
Timber	62.6800	9.0000	564.1200 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 14013.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 330.0363 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	5.7000	0.0190	0.1083
E3 Sill	4.7900	0.0220	0.1054
E4 Jamb	11.0000	0.0170	0.1870
E5 Ground floor (normal)	20.8400	0.0580	1.2087
E10 Eaves (insulation at ceiling level)	1.7200	0.0570	0.0980
E12 Gable (insulation at ceiling level)	2.2600	0.0430	0.0972
E16 Corner (normal)	7.2600	0.0420	0.3049
E17 Corner (inverted – internal area greater than external area)	2.4200	-0.0900	-0.2178
E18 Party wall between dwellings	14.5200	0.0330	0.4792
P1 Party wall - Ground floor	12.1300	0.0430	0.5216

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 2.8925 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 26.7124 (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	20.2271	20.1000	19.9754	19.3903	19.2809	18.7713	18.7713	18.6769	18.9675	19.2809	19.5023	19.7338	(38)
Heat transfer coeff	46.9395	46.8125	46.6879	46.1028	45.9933	45.4837	45.4837	45.3893	45.6800	45.9933	46.2148	46.4463	(39)

Average = Sum(39)m / 12 = 46.1023

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1055	1.1025	1.0996	1.0858	1.0832	1.0712	1.0712	1.0690	1.0758	1.0832	1.0884	1.0939	(40)
HLP (average)												1.0858	
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 1.4731 (42)
Hot water usage for mixer showers

70.6069	69.5458	67.9996	65.0412	62.8580	60.4233	59.0394	60.5739	62.2560	64.8701	67.8921	70.3364	(42a)

Hot water usage for baths

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

29.7165	28.6359	27.5553	26.4747	25.3941	24.3135	24.3135	25.3941	26.4747	27.5553	28.6359	29.7165	(42c)

Average daily hot water use (litres/day) 92.1122 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.3234	98.1817	95.5549	91.5159	88.2521	84.7368	83.3529	85.9680	88.7307	92.4254	96.5280	100.0528	(44)
Energy conte	158.8877	139.8094	146.8643	125.2807	118.8042	104.1937	100.8081	106.4463	109.4138	125.4204	137.5218	156.6586	(45)

Energy content (annual) Total = Sum(45)m = 1530.1090
Distribution loss (46)m = 0.15 x (45)m

23.8332	20.9714	22.0296	18.7921	17.8206	15.6291	15.1212	15.9669	16.4121	18.8131	20.6283	23.4988	(46)

Water storage loss:
Store volume 170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8802 (55)
Total storage loss

27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)

If cylinder contains dedicated solar storage

27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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

209.4363	185.4662	197.4129	174.1987	169.3528	153.1117	151.3567	156.9949	158.3318	175.9690	186.4398	207.2072	(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													
209.4363	185.4662	197.4129	174.1987	169.3528	153.1117	151.3567	156.9949	158.3318	175.9690	186.4398	207.2072	(64)

Total per year (kWh/year) = Sum(64)m = 2125.2780 (64)
12Total per year (kWh/year) 2125 (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

93.2690	83.0121	89.2713	80.7902	79.9413	73.7788	73.9576	75.8323	75.5145	82.1412	84.8604	92.5279	(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	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	(66)

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

68.6062	75.9569	68.6062	70.8931	68.6062	70.8931	68.6062	68.6062	70.8931	68.6062	70.8931	68.6062	(67)

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

127.7663	129.0921	125.7511	118.6385	109.6601	101.2217	95.5843	94.2585	97.5995	104.7121	113.6905	122.1289	(68)

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

	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)												
	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	(71)
Water heating gains (Table 5)												
	125.3616	123.5299	119.9882	112.2086	107.4480	102.4706	99.4053	101.9251	104.8812	110.4048	117.8616	124.3654 (72)
Total internal gains												
	369.8313	376.6761	362.4428	349.8374	333.8115	319.6825	308.6930	309.8870	318.4710	331.8203	350.5424	363.1977 (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	1.8000	11.2829	0.6300	0.8000	0.7700	7.0935	(75)
Southwest	3.5900	36.7938	0.6300	0.8000	0.7700	46.1353	(79)

Solar gains	53.2288	93.0244	133.5385	175.9507	206.6542	209.3714	200.1037	176.5536	148.1248	104.4992	64.1849	45.2751 (83)
Total gains	423.0601	469.7005	495.9812	525.7881	540.4657	529.0540	508.7967	486.4406	466.5958	436.3195	414.7273	408.4728 (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	82.9278	83.1530	83.3748	84.4330	84.6339	85.5822	85.5822	85.7601	85.2144	84.6339	84.2284	83.8085	
alpha	6.5285	6.5435	6.5583	6.6289	6.6423	6.7055	6.7055	6.7173	6.6810	6.6423	6.6152	6.5872	
util living area													
	0.9917	0.9824	0.9616	0.8932	0.7495	0.5457	0.3929	0.4284	0.6587	0.9055	0.9797	0.9932	(86)
MIT	20.2612	20.4071	20.5940	20.8206	20.9539	20.9951	20.9995	20.9992	20.9841	20.8306	20.5200	20.2391	(87)
Th 2	19.9963	19.9988	20.0012	20.0125	20.0146	20.0244	20.0244	20.0262	20.0206	20.0146	20.0103	20.0058	(88)
util rest of house													
	0.9884	0.9758	0.9471	0.8574	0.6852	0.4648	0.3060	0.3382	0.5732	0.8658	0.9707	0.9906	(89)
MIT 2	19.1673	19.3519	19.5829	19.8519	19.9830	20.0223	20.0243	20.0260	20.0127	19.8704	19.5040	19.1470	(90)
Living area fraction										fLA = Living area / (4) =		0.4366	(91)
MIT	19.6449	19.8126	20.0244	20.2749	20.4069	20.4471	20.4501	20.4510	20.4369	20.2897	19.9476	19.6238	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6449	19.8126	20.0244	20.2749	20.4069	20.4471	20.4501	20.4510	20.4369	20.2897	19.9476	19.6238	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9870	0.9742	0.9475	0.8678	0.7118	0.5002	0.3440	0.3776	0.6104	0.8782	0.9700	0.9892	(94)
Useful gains	417.5494	457.5970	469.9451	456.2675	384.7076	264.6270	175.0284	183.7040	284.8229	383.1618	402.2721	404.0729	(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													
	720.2837	698.0977	631.4260	524.4130	400.4606	265.9472	175.1184	183.8701	289.4675	445.6597	593.7511	716.3800	(97)
Space heating kWh													
	225.2343	161.6165	120.1418	49.0647	11.7203	0.0000	0.0000	0.0000	0.0000	46.4985	137.8649	232.3565	(98a)
Space heating requirement - total per year (kWh/year)												984.4975	
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													
	225.2343	161.6165	120.1418	49.0647	11.7203	0.0000	0.0000	0.0000	0.0000	46.4985	137.8649	232.3565	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												984.4975	
Space heating per m2											(98c) / (4) =	23.1865	(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 %)													170.0000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	225.2343	161.6165	120.1418	49.0647	11.7203	0.0000	0.0000	0.0000	0.0000	46.4985	137.8649	232.3565	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	132.4908	95.0685	70.6716	28.8616	6.8943	0.0000	0.0000	0.0000	0.0000	27.3520	81.0970	136.6803	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement												
	209.4363	185.4662	197.4129	174.1987	169.3528	153.1117	151.3567	156.9949	158.3318	175.9690	186.4398	207.2072 (64)
Efficiency of water heater												170.0000 (216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (217)
Fuel for water heating, kWh/month												
	123.1978	109.0978	116.1252	102.4698	99.6193	90.0657	89.0333	92.3500	93.1364	103.5112	109.6705	121.8866 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	17.5999	14.1193	12.7129	9.3140	7.1944	5.8779	6.5630	8.5308	11.0807	14.5384	16.4211	18.0891 (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	579.1162 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	170.0000
Water heating fuel used	1250.1635 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	142.0415 (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	1971.3212 (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	579.1162	0.1570	90.9014	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1250.1635	0.1408	176.0087	(264)
Space and water heating			266.9101	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	142.0415	0.1443	20.5010	(268)
Total CO2, kg/year			287.4110	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			6.7700	(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	579.1162	1.5811	915.6393	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1250.1635	1.5206	1900.9730	(278)
Space and water heating			2816.6123	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	142.0415	1.5338	217.8680	(282)
Total Primary energy kWh/year			3034.4804	(286)
Dwelling Primary energy Rate (DPER)			71.4700	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.4600 (1b)	x	2.4200 (2b)	=	102.7532 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 42.4600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	102.7532 (5)	

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1946 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4446 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3446 (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	0.4394	0.4307	0.4221	0.3791	0.3704	0.3274	0.3274	0.3188	0.3446	0.3704	0.3877	0.4049	(22b)
Effective ac	0.5965	0.5928	0.5891	0.5718	0.5686	0.5536	0.5536	0.5508	0.5594	0.5686	0.5751	0.5820	(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 Opaque door			1.9100	1.0000	1.9100			(26)
TER Opening Type (Uw = 1.20)			5.3900	1.1450	6.1718			(27)
Heat Loss Floor			42.4600	0.1300	5.5198			(28a)
External Walls	62.1500	7.3000	54.8500	0.1800	9.8730			(29a)
Plane Roof	3.8800		3.8800	0.1100	0.4268			(30)
Total net area of external elements Aum(A, m2)			108.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.9014			(33)
Party Wall			17.6400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 339.1013 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	5.7000	0.0500	0.2850
E3 Sill	4.7900	0.0500	0.2395
E4 Jamb	11.0000	0.0500	0.5500
E5 Ground floor (normal)	20.8400	0.1600	3.3344
E10 Eaves (insulation at ceiling level)	1.7200	0.0600	0.1032
E12 Gable (insulation at ceiling level)	2.2600	0.0600	0.1356
E16 Corner (normal)	7.2600	0.0900	0.6534
E17 Corner (inverted – internal area greater than external area)	2.4200	-0.0900	-0.2178
E18 Party wall between dwellings	14.5200	0.0600	0.8712
P1 Party wall - Ground floor	12.1300	0.0800	0.9704

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.9249 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	30.8263 (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	20.2271	20.1000	19.9754	19.3903	19.2809	18.7713	18.7713	18.6769	18.9675	19.2809	19.5023	19.7338	(38)
Heat transfer coeff	51.0534	50.9263	50.8017	50.2166	50.1071	49.5975	49.5975	49.5031	49.7938	50.1071	50.3286	50.5601	(39)
Average = Sum(39)m / 12 =												50.2161	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2024	1.1994	1.1965	1.1827	1.1801	1.1681	1.1681	1.1659	1.1727	1.1801	1.1853	1.1908	(40)
HLP (average)												1.1827	
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 1.4731 (42)
Hot water usage for mixer showers
62.7617 61.8185 60.4441 57.8144 55.8738 53.7096 52.4795 53.8435 55.3387 57.6623 60.3485 62.5212 (42a)
Hot water usage for baths
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (42b)
Hot water usage for other uses
29.7165 28.6359 27.5553 26.4747 25.3941 24.3135 24.3135 25.3941 26.4747 27.5553 28.6359 29.7165 (42c)
Average daily hot water use (litres/day) 84.8791 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	92.4782	90.4544	87.9994	84.2891	81.2678	78.0231	76.7929	79.2376	81.8134	85.2176	88.9844	92.2377	(44)
Energy conte	146.4628	128.8058	135.2517	115.3875	109.4021	95.9385	92.8744	98.1126	100.8840	115.6395	126.7746	144.4219	(45)
Energy content (annual)										Total = Sum(45)m =		1409.9557	
Distribution loss (46)m = 0.15 x (45)m													
	21.9694	19.3209	20.2878	17.3081	16.4103	14.3908	13.9312	14.7169	15.1326	17.3459	19.0162	21.6633	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(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													
	194.8405	172.5018	183.6294	162.2047	157.7798	142.7556	141.2521	146.4903	147.7012	164.0172	173.5917	192.7996	(62)
WWHRS	-28.6920	-25.3755	-26.5717	-22.0024	-20.5055	-17.5467	-16.4472	-17.4900	-18.1545	-21.4021	-24.2460	-28.1607	(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													
	166.1485	147.1264	157.0577	140.2023	137.2744	125.2089	124.8049	129.0004	129.5467	142.6151	149.3457	164.6390	(64)
										Total per year (kWh/year) = Sum(64)m =		1712.9699	(64)
12Total per year (kWh/year)												1713	(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)
Heat gains from water heating, kWh/month													
	87.4010	77.7847	83.6734	75.8201	75.0784	69.3532	69.5829	71.3246	70.9977	77.1523	79.6063	86.7225	(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	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	73.6573	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	70.6432	78.2122	70.6432	72.9980	70.6432	72.9980	70.6432	70.6432	72.9980	70.6432	72.9980	70.6432	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	127.7663	129.0921	125.7511	118.6385	109.6601	101.2217	95.5843	94.2585	97.5995	104.7121	113.6905	122.1289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	30.3657	(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)													
	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	-58.9258	(71)
Water heating gains (Table 5)													
	117.4745	115.7511	112.4642	105.3056	100.9118	96.3240	93.5254	95.8664	98.6078	103.6993	110.5642	116.5624	(72)
Total internal gains													
	363.9813	371.1526	356.9557	345.0394	329.3123	315.6408	304.8501	305.8653	314.3025	327.1519	345.3499	357.4318	(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	1.8000	11.2829	0.6300	0.7000	0.7700	6.2068	(75)
Southwest	3.5900	36.7938	0.6300	0.7000	0.7700	40.3684	(79)

Solar gains	46.5752	81.3964	116.8462	153.9568	180.8224	183.2000	175.0907	154.4844	129.6092	91.4368	56.1618	39.6157	(83)
Total gains	410.5564	452.5489	473.8019	498.9962	510.1348	498.8408	479.9409	460.3497	443.9117	418.5887	401.5117	397.0475	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

tau	78.3398	78.5353	78.7279	79.6452	79.8192	80.6394	80.6394	80.7931	80.3215	79.8192	79.4680	79.1041	
alpha	6.2227	6.2357	6.2485	6.3097	6.3213	6.3760	6.3760	6.3862	6.3548	6.3213	6.2979	6.2736	
util living area													
	0.9945	0.9888	0.9764	0.9324	0.8214	0.6229	0.4531	0.4918	0.7335	0.9383	0.9869	0.9955	(86)
MIT	20.1313	20.2716	20.4638	20.7209	20.9079	20.9868	20.9985	20.9975	20.9647	20.7483	20.4055	20.1106	(87)
Th 2	19.9181	19.9205	19.9228	19.9339	19.9360	19.9456	19.9456	19.9474	19.9419	19.9360	19.9318	19.9274	(88)
util rest of house													
	0.9921	0.9842	0.9662	0.9040	0.7576	0.5270	0.3455	0.3810	0.6392	0.9064	0.9804	0.9935	(89)
MIT 2	18.9396	19.1185	19.3601	19.6748	19.8700	19.9400	19.9453	19.9468	19.9239	19.7135	19.2976	18.9205	(90)
Living area fraction										fLA = Living area / (4) =		0.4366	(91)
MIT	19.4600	19.6220	19.8421	20.1316	20.3232	20.3971	20.4052	20.4056	20.3783	20.1654	19.7814	19.4401	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4600	19.6220	19.8421	20.1316	20.3232	20.3971	20.4052	20.4056	20.3783	20.1654	19.7814	19.4401	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9908	0.9825	0.9653	0.9100	0.7825	0.5690	0.3926	0.4296	0.6800	0.9145	0.9793	0.9924	(94)
Useful gains	406.7883	444.6409	457.3534	454.0950	399.1899	283.8274	188.4277	197.7668	301.8447	382.7790	393.1881	394.0183	(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													
	773.9666	749.7343	677.7989	564.0102	432.0844	287.5210	188.7261	198.2885	312.6227	479.2925	638.2363	770.5429	(97)
Space heating kWh													
	273.1807	205.0227	164.0114	79.1390	24.4735	0.0000	0.0000	0.0000	0.0000	71.8061	176.4347	280.1343	(98a)
Space heating requirement - total per year (kWh/year)												1274.2023	
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													
	273.1807	205.0227	164.0114	79.1390	24.4735	0.0000	0.0000	0.0000	0.0000	71.8061	176.4347	280.1343	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1274.2023	
Space heating per m2											(98c) / (4) =	30.0095	(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													
	273.1807	205.0227	164.0114	79.1390	24.4735	0.0000	0.0000	0.0000	0.0000	71.8061	176.4347	280.1343	(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)													
	295.9704	222.1265	177.6939	85.7410	26.5152	0.0000	0.0000	0.0000	0.0000	77.7964	191.1535	303.5041	(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													
	166.1485	147.1264	157.0577	140.2023	137.2744	125.2089	124.8049	129.0004	129.5467	142.6151	149.3457	164.6390	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.1674	84.8040	84.1571	82.8289	81.0428	79.8000	79.8000	79.8000	79.8000	82.6036	84.4346	85.2414	(217)
Fuel for water heating, kWh/month													
	195.0846	173.4898	186.6245	169.2674	169.3850	156.9034	156.3971	161.6546	162.3392	172.6499	176.8775	193.1444	(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	14.6783	11.7755	10.6025	7.7678	6.0001	4.9021	5.4735	7.1147	9.2412	12.1250	13.6952	15.0862	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-14.7321	-21.5914	-32.2600	-37.7717	-42.0707	-39.8011	-39.3611	-36.5224	-31.6979	-25.3987	-16.5023	-12.6460	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.9912	-12.8160	-25.8591	-39.3927	-52.6058	-53.0070	-52.3368	-44.0353	-31.9437	-18.4579	-8.0446	-4.7185	(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												1380.5009	(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	2073.8175 (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)	118.4621 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-699.5640 (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	2959.2165 (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	1380.5009	0.2100	289.9052	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2073.8175	0.2100	435.5017	(264)
Space and water heating			725.4069	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	118.4621	0.1443	17.0977	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-350.3554	0.1337	-46.8567	
PV Unit electricity exported	-349.2085	0.1255	-43.8270	
Total			-90.6836	(269)
Total CO2, kg/year			663.7502	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.6300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1380.5009	1.1300	1559.9660	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2073.8175	1.1300	2343.4138	(278)
Space and water heating			3903.3798	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	118.4621	1.5338	181.7011	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-350.3554	1.4942	-523.5128	
PV Unit electricity exported	-349.2085	0.4607	-160.8693	
Total			-684.3821	(283)
Total Primary energy kWh/year			3530.7996	(286)
Target Primary Energy Rate (TPER)			83.1600	(287)

Full SAP Calculation Printout

Property Reference	PR10986 - Flat 2	Issued on Date	27/09/2023
Assessment Reference	001 - Be Green	Prop Type Ref	
Property	114, Cowley Road, Oxford, Oxfordshire, OX4 3TJ		

SAP Rating	98 A	DER	6.37	TER	8.07
Environmental	95 A	% DER < TER			21.07
CO_2 Emissions (t/year)	0.45	DFEE	17.48	TFEE	18.36
Compliance Check	See BREL	% DFEE < TFEE			4.79
% DPER < TPER	20.49	DPER	33.48	TPER	42.11

Assessor Details	Mr. Iraj Maghounaki	Assessor ID	V571-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.8300 (1b)	x	2.4200 (2b)	=	6.8486 (1b)	-
First floor	42.0500 (1c)	x	2.3500 (2c)	=	98.8175 (1c)	-
Second floor	41.7700 (1d)	x	1.0000 (2d)	=	41.7700 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	147.4361	(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	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.2035	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4535	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3514	(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	0.4481	0.4393	0.4305	0.3866	0.3778	0.3339	0.3339	0.3251	0.3514	0.3778	0.3954	0.4129	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5528	0.5618	0.5714	0.5782	0.5853	(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	
Solid Door			1.8500	1.2000	2.2200			(26)
Windows (Uw = 1.20)			5.1500	1.1450	5.8969			(27)
Rooflights			1.4600	1.1450	1.6718			(27a)
Heat Loss Floor			2.8300	0.1200	0.3396	110.0000	311.3000	(28a)
External Walls	59.8500	7.0000	52.8500	0.1800	9.5130	110.0000	5813.5000	(29a)
0.72 Roof	0.3200		0.3200	0.1100	0.0352	9.0000	2.8800	(30)

Sloped Roof	49.8500	1.4600	48.3900	0.1500	7.2585	9.0000	435.5100 (30)
Total net area of external elements Aum(A, m2)			112.8500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.9350		(33)
Party Wall			32.3400	0.0000	0.0000	110.0000	3557.4000 (32)
Party Floor			39.2200			30.0000	1176.6000 (32d)
Party Ceiling			38.4900			20.0000	769.8000 (32b)
FF - Timber			71.3000			9.0000	641.7000 (32c)
SF - Timber			10.2900			9.0000	92.6100 (32c)
Internal Floor			41.7700			18.0000	751.8600 (32d)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 13553.1600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 156.4127 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.8800	0.0190	0.1307
E3 Sill	5.9800	0.0220	0.1316
E4 Jamb	12.7000	0.0170	0.2159
E5 Ground floor (normal)	1.2900	0.0580	0.0748
E6 Intermediate floor within a dwelling	22.1000	0.0010	0.0221
E7 Party floor between dwellings (in blocks of flats)	16.8400	0.0370	0.6231
E24 Eaves (insulation at ceiling level - inverted)	5.8600	0.1500	0.8790
E11 Eaves (insulation at rafter level)	17.7400	0.0180	0.3193
E13 Gable (insulation at rafter level)	7.4600	0.0400	0.2984
E16 Corner (normal)	7.0500	0.0420	0.2961
E17 Corner (inverted – internal area greater than external area)	2.3500	-0.0900	-0.2115
E18 Party wall between dwellings	5.7000	0.0330	0.1881
P2 Party wall - Intermediate floor within a dwelling	6.8900	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	4.6500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	7.4600	0.0360	0.2686
R1 Head of roof window	1.6000	0.0610	0.0976
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.6400	0.0560	0.2038
R4 Ridge (vaulted ceiling)	8.8600	0.1200	1.0632
R5 Ridge (inverted)	4.0000	0.1200	0.4800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1768 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.1118 (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	29.2115	29.0218	28.8359	27.9627	27.7993	27.0387	27.0387	26.8979	27.3317	27.7993	28.1298	28.4753	(38)
Heat transfer coeff	61.3233	61.1336	60.9477	60.0745	59.9111	59.1505	59.1505	59.0097	59.4435	59.9111	60.2416	60.5871	(39)

Average = Sum(39)m / 12 = 60.0737

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7077	0.7055	0.7034	0.6933	0.6914	0.6826	0.6826	0.6810	0.6860	0.6914	0.6952	0.6992	(40)
HLP (average)												0.6933	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5770 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	97.4448	95.9804	93.8465	89.7636	86.7505	83.3904	81.4805	83.5982	85.9197	89.5275	93.6981	97.0714	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	41.0214	39.5297	38.0380	36.5464	35.0547	33.5630	33.5630	35.0547	36.5464	38.0380	39.5297	41.0214	(42c)

Average daily hot water use (litres/day) 127.1330 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.4662	135.5101	131.8845	126.3099	121.8052	116.9533	115.0434	118.6529	122.4661	127.5655	133.2278	138.0929	(44)
Energy conte	219.2966	192.9646	202.7016	172.9120	163.9732	143.8078	139.1351	146.9171	151.0129	173.1052	189.8074	216.2200	(45)

Energy content (annual) Total = Sum(45)m = 2111.8534

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	32.8945	28.9447	30.4052	25.9368	24.5960	21.5712	20.8703	22.0376	22.6519	25.9658	28.4711	32.4330	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	32.0148	28.9114	31.9982	30.9427	31.9594	30.9136	31.9346	31.9424	30.9208	31.9686	30.9596	32.0117	(61)
Total heat required for water heating calculated for each month	251.3114	221.8760	234.6997	203.8547	195.9326	174.7214	171.0697	178.8595	181.9337	205.0738	220.7670	248.2317	(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	251.3114	221.8760	234.6997	203.8547	195.9326	174.7214	171.0697	178.8595	181.9337	205.0738	220.7670	248.2317	(64)

Total per year (kWh/year) = Sum(64)m = 2488.3312 (64)

12Total per year (kWh/year) 2488 (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	80.9198	71.3886	75.3978	65.2289	62.5109	55.5445	54.2461	56.8355	57.9420	65.5496	70.8509	79.8961	(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	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	138.1940	153.0005	138.1940	142.8005	138.1940	142.8005	138.1940	138.1940	142.8005	138.1940	142.8005	138.1940	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	232.7779	235.1934	229.1064	216.1479	199.7901	184.4161	174.1453	171.7298	177.8168	190.7753	207.1331	222.5071	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	(71)
Water heating gains (Table 5)													
	108.7632	106.2330	101.3411	90.5957	84.0201	77.1451	72.9114	76.3918	80.4750	88.1043	98.4040	107.3872	(72)
Total internal gains													
	544.3906	559.0824	533.2970	514.1996	486.6597	466.0172	446.9062	447.9712	462.7478	481.7292	512.9931	532.7438	(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	2.0500	11.2829	0.6300	0.8000	0.7700	8.0787	(75)
Southwest	3.1000	36.7938	0.6300	0.8000	0.7700	39.8383	(79)
Northeast	1.4600	16.8560	0.6300	0.8000	1.0000	11.1630	(82)

Solar gains	59.0799	107.4552	165.4602	236.4361	293.8876	304.6456	288.3420	243.4442	189.6830	123.7006	71.9984	49.7656	(83)
Total gains	603.4705	666.5376	698.7573	750.6357	780.5473	770.6628	735.2482	691.4154	652.4308	605.4298	584.9915	582.5095	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.3921	61.5826	61.7704	62.6683	62.8392	63.6472	63.6472	63.7991	63.3336	62.8392	62.4945	62.1380	
alpha	5.0928	5.1055	5.1180	5.1779	5.1893	5.2431	5.2431	5.2533	5.2222	5.1893	5.1663	5.1425	
util living area													
	0.9711	0.9514	0.9175	0.8244	0.6733	0.4851	0.3530	0.3908	0.6068	0.8502	0.9469	0.9749	(86)
MIT	20.1308	20.3049	20.5179	20.7846	20.9369	20.9906	20.9985	20.9976	20.9715	20.7840	20.4356	20.1050	(87)
Th 2	20.3340	20.3360	20.3379	20.3468	20.3484	20.3562	20.3562	20.3576	20.3532	20.3484	20.3450	20.3415	(88)
util rest of house													
	0.9661	0.9435	0.9042	0.7993	0.6349	0.4384	0.3018	0.3370	0.5563	0.8230	0.9370	0.9706	(89)
MIT 2	19.3150	19.5339	19.7986	20.1226	20.2907	20.3494	20.3554	20.3563	20.3308	20.1290	19.7069	19.2885	(90)
Living area fraction										fLA = Living area / (4) =		0.1833	(91)
MIT	19.4645	19.6752	19.9304	20.2439	20.4091	20.4669	20.4733	20.4738	20.4482	20.2490	19.8404	19.4381	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.3145	19.5252	19.7804	20.0939	20.2591	20.3169	20.3233	20.3238	20.2982	20.0990	19.6904	19.2881	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9566	0.9318	0.8914	0.7888	0.6294	0.4355	0.2992	0.3342	0.5519	0.8114	0.9251	0.9619	(94)
Useful gains	577.2918	621.1088	622.8655	592.0995	491.3113	335.6183	219.9578	231.0517	360.0928	491.2528	541.1841	560.2944	(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													
	920.7397	894.0930	809.4093	672.4690	512.7866	338.1598	220.2354	231.5439	368.4442	569.0970	758.4666	914.1467	(97)
Space heating kWh													
	255.5252	183.4454	138.7885	57.8661	15.9777	0.0000	0.0000	0.0000	0.0000	57.9161	156.4434	263.2662	(98a)
Space heating requirement - total per year (kWh/year)												1129.2285	
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													
	255.5252	183.4454	138.7885	57.8661	15.9777	0.0000	0.0000	0.0000	0.0000	57.9161	156.4434	263.2662	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1129.2285	
Space heating per m2											(98c) / (4) =	13.0321	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	88.8000 (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													
	255.5252	183.4454	138.7885	57.8661	15.9777	0.0000	0.0000	0.0000	0.0000	57.9161	156.4434	263.2662	(98)
Space heating efficiency (main heating system 1)													
	88.8000	88.8000	88.8000	88.8000	88.8000	0.0000	0.0000	0.0000	0.0000	88.8000	88.8000	88.8000	(210)
Space heating fuel (main heating system)													
	287.7536	206.5827	156.2934	65.1645	17.9929	0.0000	0.0000	0.0000	0.0000	65.2208	176.1750	296.4709	(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													
	251.3114	221.8760	234.6997	203.8547	195.9326	174.7214	171.0697	178.8595	181.9337	205.0738	220.7670	248.2317	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.5015	88.4705	88.4220	88.3320	88.2450	88.2000	88.2000	88.2000	88.2000	88.3314	88.4479	88.5078	(217)
Fuel for water heating, kWh/month													
	283.9629	250.7908	265.4313	230.7825	222.0326	198.0968	193.9565	202.7885	206.2741	232.1640	249.6013	280.4631	(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	38.7250	31.0667	27.9721	20.4935	15.8298	12.9331	14.4405	18.7703	24.3807	31.9888	36.1313	39.8013	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-49.7894	-68.3933	-95.6758	-104.4726	-110.0035	-101.7090	-100.5886	-96.4510	-88.4698	-77.0342	-54.1693	-43.2728	(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	-33.4868	-69.8724	-137.8752	-205.6116	-270.4529	-271.2393	-267.8981	-227.2690	-167.2734	-99.2030	-44.4722	-26.5060	(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	1271.6537 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	88.2000
Water heating fuel used	2816.3445 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	312.5332 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2811.1894 (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	1675.3421 (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	1271.6537	0.2100	267.0473	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2816.3445	0.2100	591.4323	(264)
Space and water heating			858.4796	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	312.5332	0.1443	45.1082	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-990.0293	0.1352	-133.8330	
PV Unit electricity exported	-1821.1601	0.1261	-229.6759	
Total			-363.5089	(269)
Total CO2, kg/year			552.0082	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			6.3700	(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	1271.6537	1.1300	1436.9687 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2816.3445	1.1300	3182.4693 (278)
Space and water heating			4619.4380 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	312.5332	1.5338	479.3739 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-990.0293	1.4996	-1484.6865
PV Unit electricity exported	-1821.1601	0.4629	-843.0872
Total			-2327.7736 (283)
Total Primary energy kWh/year			2901.1390 (286)
Dwelling Primary energy Rate (DPER)			33.4800 (287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.8300 (1b)	x	2.4200 (2b)	=	6.8486 (1b)	-
First floor	42.0500 (1c)	x	2.3500 (2c)	=	98.8175 (1c)	-
Second floor	41.7700 (1d)	x	1.0000 (2d)	=	41.7700 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	147.4361	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.2035	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4535	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3514	(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	0.4481	0.4393	0.4305	0.3866	0.3778	0.3339	0.3339	0.3251	0.3514	0.3778	0.3954	0.4129	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5528	0.5618	0.5714	0.5782	0.5853	(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 Opaque door			1.8500	1.0000	1.8500			(26)
TER Opening Type (Uw = 1.20)			5.1500	1.1450	5.8969			(27)
Rooflights			1.4600	1.5038	2.1955			(27a)
Heat Loss Floor			2.8300	0.1300	0.3679			(28a)
External Walls	59.8500	7.0000	52.8500	0.1800	9.5130			(29a)
0.72 Roof	0.3200		0.3200	0.1100	0.0352			(30)
Sloped Roof	49.8500	1.4600	48.3900	0.1100	5.3229			(30)
Total net area of external elements Aum(A, m2)			112.8500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.1814			(33)
Party Wall			32.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 160.8547 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.8800	0.0500	0.3440
E3 Sill	5.9800	0.0500	0.2990
E4 Jamb	12.7000	0.0500	0.6350
E5 Ground floor (normal)	1.2900	0.1600	0.2064
E6 Intermediate floor within a dwelling	22.1000	0.0000	0.0000
E7 Party floor between dwellings (in blocks of flats)	16.8400	0.0700	1.1788
E24 Eaves (insulation at ceiling level - inverted)	5.8600	0.2400	1.4064
E11 Eaves (insulation at rafter level)	17.7400	0.0400	0.7096
E13 Gable (insulation at rafter level)	7.4600	0.0800	0.5968
E16 Corner (normal)	7.0500	0.0900	0.6345
E17 Corner (inverted – internal area greater than external area)	2.3500	-0.0900	-0.2115
E18 Party wall between dwellings	5.7000	0.0600	0.3420
P2 Party wall - Intermediate floor within a dwelling	6.8900	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	4.6500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	7.4600	0.0800	0.5968
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.6400	0.0800	0.2912
R4 Ridge (vaulted ceiling)	8.8600	0.0800	0.7088
R5 Ridge (inverted)	4.0000	0.0400	0.1600

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1218 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 33.3032 (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	29.2115	29.0218	28.8359	27.9627	27.7993	27.0387	27.0387	26.8979	27.3317	27.7993	28.1298	28.4753	(38)
Heat transfer coeff	62.5147	62.3251	62.1391	61.2659	61.1025	60.3419	60.3419	60.2011	60.6349	61.1025	61.4330	61.7786	(39)

Average = Sum(39)m / 12 = 61.2651

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7215	0.7193	0.7171	0.7071	0.7052	0.6964	0.6964	0.6948	0.6998	0.7052	0.7090	0.7130	(40)
HLP (average)												0.7070	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5770 (42)

Hot water usage for mixer showers

86.6176	85.3159	83.4191	79.7898	77.1116	74.1248	72.4271	74.3095	76.3731	79.5800	83.2872	86.2857	(42a)

Hot water usage for baths

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

41.0214	39.5297	38.0380	36.5464	35.0547	33.5630	33.5630	35.0547	36.5464	38.0380	39.5297	41.0214	(42c)

Average daily hot water use (litres/day) 117.1507 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	127.6390	124.8456	121.4571	116.3362	112.1662	107.6877	105.9901	109.3642	112.9194	117.6180	122.8169	127.3071	(44)
Energy conte	202.1490	177.7785	186.6751	159.2584	150.9973	132.4146	128.1858	135.4157	139.2410	159.6066	174.9752	199.3322	(45)

Energy content (annual) Total = Sum(45)m = 1946.0294

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

30.3223	26.6668	28.0013	23.8888	22.6496	19.8622	19.2279	20.3124	20.8861	23.9410	26.2463	29.8998	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

253.1079	223.8059	237.6340	208.5735	201.9562	181.7297	179.1447	186.3746	188.5560	210.5655	224.2903	250.2911	(62)
WWHRS -39.5979	-35.0207	-36.6717	-30.3656	-28.2997	-24.2162	-22.6989	-24.1380	-25.0550	-29.5371	-33.4620	-38.8646	(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

213.5099	188.7852	200.9623	178.2079	173.6565	157.5135	156.4458	162.2367	163.5010	181.0283	190.8283	211.4265	(64)

Total per year (kWh/year) = Sum(64)m = 2178.1018 (64)

12Total per year (kWh/year) 2178 (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

79.9543	70.6182	74.8092	65.2822	62.9463	56.3566	55.3615	57.7655	58.6264	65.8089	70.5080	79.0177	(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	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	141.8124	157.0066	141.8124	146.5395	141.8124	146.5395	141.8124	141.8124	146.5395	141.8124	146.5395	141.8124	(67)

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

	232.7779	235.1934	229.1064	216.1479	199.7901	184.4161	174.1453	171.7298	177.8168	190.7753	207.1331	222.5071	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	(71)
Water heating gains (Table 5)													
	107.4654	105.0866	100.5500	90.6697	84.6053	78.2731	74.4106	77.6417	81.4255	88.4528	97.9278	106.2066	(72)
Total internal gains													
	546.7112	561.9421	536.1243	518.0126	490.8633	470.8842	452.0239	452.8395	467.4374	485.6961	516.2559	535.1816	(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	2.0500	11.2829	0.6300	0.7000	0.7700	7.0688	(75)
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585	(79)
Northeast	1.4600	16.8560	0.6300	0.7000	1.0000	9.7676	(82)

Solar gains	51.6949	94.0233	144.7777	206.8816	257.1516	266.5649	252.2992	213.0137	165.9726	108.2380	62.9986	43.5449	(83)
Total gains	598.4061	655.9654	680.9020	724.8942	748.0149	737.4491	704.3231	665.8532	633.4100	593.9341	579.2545	578.7265	(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	61.9323	62.1208	62.3067	63.1948	63.3637	64.1624	64.1624	64.3125	63.8524	63.3637	63.0228	62.6703	
alpha	5.1288	5.1414	5.1538	5.2130	5.2242	5.2775	5.2775	5.2875	5.2568	5.2242	5.2015	5.1780	
util living area													
	0.9746	0.9580	0.9298	0.8483	0.7067	0.5153	0.3756	0.4135	0.6331	0.8663	0.9530	0.9779	(86)
MIT	20.1093	20.2747	20.4815	20.7547	20.9230	20.9880	20.9981	20.9969	20.9663	20.7652	20.4145	20.0856	(87)
Th 2	20.3219	20.3238	20.3257	20.3346	20.3363	20.3440	20.3440	20.3455	20.3410	20.3363	20.3329	20.3294	(88)
util rest of house													
	0.9701	0.9508	0.9177	0.8244	0.6676	0.4653	0.3202	0.3557	0.5807	0.8400	0.9438	0.9739	(89)
MIT 2	19.2774	19.4860	19.7441	20.0782	20.2656	20.3354	20.3431	20.3438	20.3146	20.0971	19.6703	19.2534	(90)
Living area fraction										fLA = Living area / (4) =		0.1833	(91)
MIT	19.4299	19.6305	19.8792	20.2022	20.3861	20.4550	20.4631	20.4635	20.4341	20.2195	19.8066	19.4059	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4299	19.6305	19.8792	20.2022	20.3861	20.4550	20.4631	20.4635	20.4341	20.2195	19.8066	19.4059	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9419	0.9086	0.8192	0.6706	0.4739	0.3303	0.3662	0.5884	0.8349	0.9352	0.9671	(94)
Useful gains	576.0493	617.8786	618.6381	593.8550	501.6340	349.4781	232.6523	243.8500	372.6696	495.8951	541.6920	559.6829	(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													
	945.8421	918.0792	831.3732	692.4376	530.7435	353.3029	233.1084	244.6281	384.0649	587.7771	780.6079	939.3974	(97)
Space heating kWh													
	275.1258	201.7348	158.2749	70.9795	21.6575	0.0000	0.0000	0.0000	0.0000	68.3601	172.0194	282.5076	(98a)
Space heating requirement - total per year (kWh/year)												1250.6596	
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													
	275.1258	201.7348	158.2749	70.9795	21.6575	0.0000	0.0000	0.0000	0.0000	68.3601	172.0194	282.5076	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1250.6596	
Space heating per m2											(98c) / (4) =	14.4335	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	275.1258	201.7348	158.2749	70.9795	21.6575	0.0000	0.0000	0.0000	0.0000	68.3601	172.0194	282.5076	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	297.7552	218.3277	171.2932	76.8176	23.4388	0.0000	0.0000	0.0000	0.0000	73.9828	186.1682	305.7441	(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												
	213.5099	188.7852	200.9623	178.2079	173.6565	157.5135	156.4458	162.2367	163.5010	181.0283	190.8283	211.4265 (64)
Efficiency of water heater												80.3000 (216)
(217)m	84.9258	84.5239	83.8749	82.5754	81.1707	80.3000	80.3000	80.3000	80.3000	82.4873	84.1597	85.0032 (217)
Fuel for water heating, kWh/month												
	251.4078	223.3512	239.5977	215.8124	213.9399	196.1563	194.8267	202.0382	203.6127	219.4620	226.7454	248.7277 (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	29.4658	23.6386	21.2839	15.5935	12.0449	9.8408	10.9877	14.2823	18.5513	24.3403	27.4923	30.2848 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-29.2327	-42.3953	-62.6413	-72.4344	-79.8018	-75.0804	-74.1729	-69.2220	-60.7177	-49.4108	-32.5628	-25.1379 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-13.0582	-27.8214	-55.9650	-85.0384	-113.4088	-114.3172	-112.9590	-95.1756	-69.1587	-40.0893	-17.5312	-10.2985 (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	1353.5277 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.3000
Water heating fuel used	2635.6779 (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)	237.8060 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1427.6311 (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	2885.3805 (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	1353.5277	0.2100	284.2408	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2635.6779	0.2100	553.4924	(264)
Space and water heating			837.7332	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	237.8060	0.1443	34.3228	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-672.8099	0.1340	-90.1618	
PV Unit electricity exported	-754.8212	0.1256	-94.7725	
Total			-184.9343	(269)
Total CO2, kg/year			699.0509	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.0700	(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	1353.5277	1.1300	1529.4863	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2635.6779	1.1300	2978.3161	(278)
Space and water heating			4507.8024	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	237.8060	1.5338	364.7548	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-672.8099	1.4952	-1006.0110	
PV Unit electricity exported	-754.8212	0.4609	-347.8679	
Total			-1353.8789	(283)
Total Primary energy kWh/year			3648.7791	(286)
Target Primary Energy Rate (TPER)			42.1100	(287)

Full SAP Calculation Printout

Property Reference	PR10986 - Flat 2	Issued on Date	27/09/2023
Assessment Reference	002 - Be Lean	Prop Type Ref	
Property	114, Cowley Road, Oxford, Oxfordshire, OX4 3TJ		

SAP Rating	87 B	DER	10.57	TER	8.07
Environmental	91 B	% DER < TER			-30.98
CO_2 Emissions (t/year)	0.84	DFEE	17.48	TFEE	18.36
Compliance Check	See BREL	% DFEE < TFEE			4.79
% DPER < TPER	-43.30	DPER	60.35	TPER	42.11

Assessor Details	Mr. Iraj Maghounaki	Assessor ID	V571-0001
Client			

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		2.8300 (1b)	x	2.4200 (2b)	=	6.8486 (1b)	-
First floor		42.0500 (1c)	x	2.3500 (2c)	=	98.8175 (1c)	-
Second floor		41.7700 (1d)	x	1.0000 (2d)	=	41.7700 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.6500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	147.4361	(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	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.2035	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4535	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3514	(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	0.4481	0.4393	0.4305	0.3866	0.3778	0.3339	0.3339	0.3251	0.3514	0.3778	0.3954	0.4129	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5528	0.5618	0.5714	0.5782	0.5853	(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	
Solid Door			1.8500	1.2000	2.2200			(26)
Windows (Uw = 1.20)			5.1500	1.1450	5.8969			(27)
Rooflights			1.4600	1.1450	1.6718			(27a)
Heat Loss Floor			2.8300	0.1200	0.3396	110.0000	311.3000	(28a)
External Walls	59.8500	7.0000	52.8500	0.1800	9.5130	110.0000	5813.5000	(29a)
0.72 Roof	0.3200		0.3200	0.1100	0.0352	9.0000	2.8800	(30)

Sloped Roof	49.8500	1.4600	48.3900	0.1500	7.2585	9.0000	435.5100 (30)
Total net area of external elements Aum(A, m2)			112.8500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.9350		(33)
Party Wall			32.3400	0.0000	0.0000	110.0000	3557.4000 (32)
Party Floor			39.2200			30.0000	1176.6000 (32d)
Party Ceiling			38.4900			20.0000	769.8000 (32b)
FF - Timber			71.3000			9.0000	641.7000 (32c)
SF - Timber			10.2900			9.0000	92.6100 (32c)
Internal Floor			41.7700			18.0000	751.8600 (32d)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 13553.1600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 156.4127 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.8800	0.0190	0.1307
E3 Sill	5.9800	0.0220	0.1316
E4 Jamb	12.7000	0.0170	0.2159
E5 Ground floor (normal)	1.2900	0.0580	0.0748
E6 Intermediate floor within a dwelling	22.1000	0.0010	0.0221
E7 Party floor between dwellings (in blocks of flats)	16.8400	0.0370	0.6231
E24 Eaves (insulation at ceiling level - inverted)	5.8600	0.1500	0.8790
E11 Eaves (insulation at rafter level)	17.7400	0.0180	0.3193
E13 Gable (insulation at rafter level)	7.4600	0.0400	0.2984
E16 Corner (normal)	7.0500	0.0420	0.2961
E17 Corner (inverted – internal area greater than external area)	2.3500	-0.0900	-0.2115
E18 Party wall between dwellings	5.7000	0.0330	0.1881
P2 Party wall - Intermediate floor within a dwelling	6.8900	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	4.6500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	7.4600	0.0360	0.2686
R1 Head of roof window	1.6000	0.0610	0.0976
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.6400	0.0560	0.2038
R4 Ridge (vaulted ceiling)	8.8600	0.1200	1.0632
R5 Ridge (inverted)	4.0000	0.1200	0.4800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1768 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.1118 (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	29.2115	29.0218	28.8359	27.9627	27.7993	27.0387	27.0387	26.8979	27.3317	27.7993	28.1298	28.4753	(38)
Heat transfer coeff	61.3233	61.1336	60.9477	60.0745	59.9111	59.1505	59.1505	59.0097	59.4435	59.9111	60.2416	60.5871	(39)

Average = Sum(39)m / 12 = 60.0737

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7077	0.7055	0.7034	0.6933	0.6914	0.6826	0.6826	0.6810	0.6860	0.6914	0.6952	0.6992	(40)
HLP (average)												0.6933	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5770 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	97.4448	95.9804	93.8465	89.7636	86.7505	83.3904	81.4805	83.5982	85.9197	89.5275	93.6981	97.0714	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	41.0214	39.5297	38.0380	36.5464	35.0547	33.5630	33.5630	35.0547	36.5464	38.0380	39.5297	41.0214	(42c)

Average daily hot water use (litres/day) 127.1330 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	138.4662	135.5101	131.8845	126.3099	121.8052	116.9533	115.0434	118.6529	122.4661	127.5655	133.2278	138.0929	(44)
Energy conte	219.2966	192.9646	202.7016	172.9120	163.9732	143.8078	139.1351	146.9171	151.0129	173.1052	189.8074	216.2200	(45)

Energy content (annual) Total = Sum(45)m = 2111.8534

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	32.8945	28.9447	30.4052	25.9368	24.5960	21.5712	20.8703	22.0376	22.6519	25.9658	28.4711	32.4330	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	32.0148	28.9114	31.9982	30.9427	31.9594	30.9136	31.9346	31.9424	30.9208	31.9686	30.9596	32.0117	(61)
Total heat required for water heating calculated for each month	251.3114	221.8760	234.6997	203.8547	195.9326	174.7214	171.0697	178.8595	181.9337	205.0738	220.7670	248.2317	(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	251.3114	221.8760	234.6997	203.8547	195.9326	174.7214	171.0697	178.8595	181.9337	205.0738	220.7670	248.2317	(64)

Total per year (kWh/year) = Sum(64)m = 2488.3312 (64)

12Total per year (kWh/year) 2488 (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	80.9198	71.3886	75.3978	65.2289	62.5109	55.5445	54.2461	56.8355	57.9420	65.5496	70.8509	79.8961	(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	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	138.1940	153.0005	138.1940	142.8005	138.1940	142.8005	138.1940	138.1940	142.8005	138.1940	142.8005	138.1940	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	232.7779	235.1934	229.1064	216.1479	199.7901	184.4161	174.1453	171.7298	177.8168	190.7753	207.1331	222.5071	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	(71)
Water heating gains (Table 5)													
	108.7632	106.2330	101.3411	90.5957	84.0201	77.1451	72.9114	76.3918	80.4750	88.1043	98.4040	107.3872	(72)
Total internal gains													
	544.3906	559.0824	533.2970	514.1996	486.6597	466.0172	446.9062	447.9712	462.7478	481.7292	512.9931	532.7438	(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	2.0500	11.2829	0.6300	0.8000	0.7700	8.0787	(75)
Southwest	3.1000	36.7938	0.6300	0.8000	0.7700	39.8383	(79)
Northeast	1.4600	16.8560	0.6300	0.8000	1.0000	11.1630	(82)

Solar gains	59.0799	107.4552	165.4602	236.4361	293.8876	304.6456	288.3420	243.4442	189.6830	123.7006	71.9984	49.7656	(83)
Total gains	603.4705	666.5376	698.7573	750.6357	780.5473	770.6628	735.2482	691.4154	652.4308	605.4298	584.9915	582.5095	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	61.3921	61.5826	61.7704	62.6683	62.8392	63.6472	63.6472	63.7991	63.3336	62.8392	62.4945	62.1380	
alpha	5.0928	5.1055	5.1180	5.1779	5.1893	5.2431	5.2431	5.2533	5.2222	5.1893	5.1663	5.1425	
util living area													
	0.9711	0.9514	0.9175	0.8244	0.6733	0.4851	0.3530	0.3908	0.6068	0.8502	0.9469	0.9749	(86)
MIT	20.1308	20.3049	20.5179	20.7846	20.9369	20.9906	20.9985	20.9976	20.9715	20.7840	20.4356	20.1050	(87)
Th 2	20.3340	20.3360	20.3379	20.3468	20.3484	20.3562	20.3562	20.3576	20.3532	20.3484	20.3450	20.3415	(88)
util rest of house													
	0.9661	0.9435	0.9042	0.7993	0.6349	0.4384	0.3018	0.3370	0.5563	0.8230	0.9370	0.9706	(89)
MIT 2	19.3150	19.5339	19.7986	20.1226	20.2907	20.3494	20.3554	20.3563	20.3308	20.1290	19.7069	19.2885	(90)
Living area fraction										fLA = Living area / (4) =		0.1833	(91)
MIT	19.4645	19.6752	19.9304	20.2439	20.4091	20.4669	20.4733	20.4738	20.4482	20.2490	19.8404	19.4381	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.3145	19.5252	19.7804	20.0939	20.2591	20.3169	20.3233	20.3238	20.2982	20.0990	19.6904	19.2881	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9566	0.9318	0.8914	0.7888	0.6294	0.4355	0.2992	0.3342	0.5519	0.8114	0.9251	0.9619	(94)
Useful gains	577.2918	621.1088	622.8655	592.0995	491.3113	335.6183	219.9578	231.0517	360.0928	491.2528	541.1841	560.2944	(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													
	920.7397	894.0930	809.4093	672.4690	512.7866	338.1598	220.2354	231.5439	368.4442	569.0970	758.4666	914.1467	(97)
Space heating kWh													
	255.5252	183.4454	138.7885	57.8661	15.9777	0.0000	0.0000	0.0000	0.0000	57.9161	156.4434	263.2662	(98a)
Space heating requirement - total per year (kWh/year)												1129.2285	
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													
	255.5252	183.4454	138.7885	57.8661	15.9777	0.0000	0.0000	0.0000	0.0000	57.9161	156.4434	263.2662	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1129.2285	
Space heating per m2											(98c) / (4) =	13.0321	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	88.8000 (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													
	255.5252	183.4454	138.7885	57.8661	15.9777	0.0000	0.0000	0.0000	0.0000	57.9161	156.4434	263.2662	(98)
Space heating efficiency (main heating system 1)													
	88.8000	88.8000	88.8000	88.8000	88.8000	0.0000	0.0000	0.0000	0.0000	88.8000	88.8000	88.8000	(210)
Space heating fuel (main heating system)													
	287.7536	206.5827	156.2934	65.1645	17.9929	0.0000	0.0000	0.0000	0.0000	65.2208	176.1750	296.4709	(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													
	251.3114	221.8760	234.6997	203.8547	195.9326	174.7214	171.0697	178.8595	181.9337	205.0738	220.7670	248.2317	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.5015	88.4705	88.4220	88.3320	88.2450	88.2000	88.2000	88.2000	88.2000	88.3314	88.4479	88.5078	(217)
Fuel for water heating, kWh/month													
	283.9629	250.7908	265.4313	230.7825	222.0326	198.0968	193.9565	202.7885	206.2741	232.1640	249.6013	280.4631	(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	38.7250	31.0667	27.9721	20.4935	15.8298	12.9331	14.4405	18.7703	24.3807	31.9888	36.1313	39.8013	(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	1271.6537 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	88.2000
Water heating fuel used	2816.3445 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	312.5332 (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	4486.5314 (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	1271.6537	0.2100	267.0473	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2816.3445	0.2100	591.4323	(264)
Space and water heating			858.4796	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	312.5332	0.1443	45.1082	(268)
Total CO2, kg/year			915.5171	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.5700	(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	1271.6537	1.1300	1436.9687	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2816.3445	1.1300	3182.4693	(278)
Space and water heating			4619.4380	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)

Energy for lighting	312.5332	1.5338	479.3739 (282)
Total Primary energy kWh/year			5228.9127 (286)
Dwelling Primary energy Rate (DPER)			60.3500 (287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	2.8300 (1b)	x	2.4200 (2b)	=	6.8486 (1b)	-
First floor	42.0500 (1c)	x	2.3500 (2c)	=	98.8175 (1c)	-
Second floor	41.7700 (1d)	x	1.0000 (2d)	=	41.7700 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	147.4361	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.2035	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4535	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3514	(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	0.4481	0.4393	0.4305	0.3866	0.3778	0.3339	0.3339	0.3251	0.3514	0.3778	0.3954	0.4129	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5528	0.5618	0.5714	0.5782	0.5853	(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 Opaque door			1.8500	1.0000	1.8500			(26)
TER Opening Type (Uw = 1.20)			5.1500	1.1450	5.8969			(27)
Rooflights			1.4600	1.5038	2.1955			(27a)
Heat Loss Floor			2.8300	0.1300	0.3679			(28a)
External Walls	59.8500	7.0000	52.8500	0.1800	9.5130			(29a)
0.72 Roof	0.3200		0.3200	0.1100	0.0352			(30)
Sloped Roof	49.8500	1.4600	48.3900	0.1100	5.3229			(30)
Total net area of external elements Aum(A, m2)			112.8500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.1814			(33)
Party Wall			32.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 160.8547 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	6.8800	0.0500	0.3440
E3 Sill	5.9800	0.0500	0.2990
E4 Jamb	12.7000	0.0500	0.6350
E5 Ground floor (normal)	1.2900	0.1600	0.2064
E6 Intermediate floor within a dwelling	22.1000	0.0000	0.0000
E7 Party floor between dwellings (in blocks of flats)	16.8400	0.0700	1.1788
E24 Eaves (insulation at ceiling level - inverted)	5.8600	0.2400	1.4064

E11 Eaves (insulation at rafter level)	17.7400	0.0400	0.7096
E13 Gable (insulation at rafter level)	7.4600	0.0800	0.5968
E16 Corner (normal)	7.0500	0.0900	0.6345
E17 Corner (inverted – internal area greater than external area)	2.3500	-0.0900	-0.2115
E18 Party wall between dwellings	5.7000	0.0600	0.3420
P2 Party wall - Intermediate floor within a dwelling	6.8900	0.0000	0.0000
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	4.6500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	7.4600	0.0800	0.5968
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.6400	0.0800	0.2912
R4 Ridge (vaulted ceiling)	8.8600	0.0800	0.7088
R5 Ridge (inverted)	4.0000	0.0400	0.1600

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.1218 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 33.3032 (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	29.2115	29.0218	28.8359	27.9627	27.7993	27.0387	27.0387	26.8979	27.3317	27.7993	28.1298	28.4753	(38)
Heat transfer coeff	62.5147	62.3251	62.1391	61.2659	61.1025	60.3419	60.3419	60.2011	60.6349	61.1025	61.4330	61.7786	(39)

Average = Sum(39)m / 12 = 61.2651

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7215	0.7193	0.7171	0.7071	0.7052	0.6964	0.6964	0.6948	0.6998	0.7052	0.7090	0.7130	(40)
HLP (average)												0.7070	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5770 (42)

Hot water usage for mixer showers

86.6176	85.3159	83.4191	79.7898	77.1116	74.1248	72.4271	74.3095	76.3731	79.5800	83.2872	86.2857	(42a)

Hot water usage for baths

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

41.0214	39.5297	38.0380	36.5464	35.0547	33.5630	33.5630	35.0547	36.5464	38.0380	39.5297	41.0214	(42c)

Average daily hot water use (litres/day) 117.1507 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	127.6390	124.8456	121.4571	116.3362	112.1662	107.6877	105.9901	109.3642	112.9194	117.6180	122.8169	127.3071	(44)
Energy conte	202.1490	177.7785	186.6751	159.2584	150.9973	132.4146	128.1858	135.4157	139.2410	159.6066	174.9752	199.3322	(45)

Energy content (annual) Total = Sum(45)m = 1946.0294

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

30.3223	26.6668	28.0013	23.8888	22.6496	19.8622	19.2279	20.3124	20.8861	23.9410	26.2463	29.8998	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

253.1079	223.8059	237.6340	208.5735	201.9562	181.7297	179.1447	186.3746	188.5560	210.5655	224.2903	250.2911	(62)
WWHRS -39.5979	-35.0207	-36.6717	-30.3656	-28.2997	-24.2162	-22.6989	-24.1380	-25.0550	-29.5371	-33.4620	-38.8646	(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

213.5099	188.7852	200.9623	178.2079	173.6565	157.5135	156.4458	162.2367	163.5010	181.0283	190.8283	211.4265	(64)

Total per year (kWh/year) = Sum(64)m = 2178.1018 (64)

12Total per year (kWh/year) 2178 (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

79.9543	70.6182	74.8092	65.2822	62.9463	56.3566	55.3615	57.7655	58.6264	65.8089	70.5080	79.0177	(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	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	128.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	141.8124	157.0066	141.8124	146.5395	141.8124	146.5395	141.8124	141.8124	146.5395	141.8124	146.5395	141.8124	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	232.7779	235.1934	229.1064	216.1479	199.7901	184.4161	174.1453	171.7298	177.8168	190.7753	207.1331	222.5071	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	35.8852	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000		(70)
Losses e.g. evaporation (negative values) (Table 5)	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	-103.0814	(71)
Water heating gains (Table 5)	107.4654	105.0866	100.5500	90.6697	84.6053	78.2731	74.4106	77.6417	81.4255	88.4528	97.9278	106.2066	(72)
Total internal gains	546.7112	561.9421	536.1243	518.0126	490.8633	470.8842	452.0239	452.8395	467.4374	485.6961	516.2559	535.1816	(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	2.0500	11.2829	0.6300	0.7000	0.7700	7.0688 (75)
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)
Northeast	1.4600	16.8560	0.6300	0.7000	1.0000	9.7676 (82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	51.6949	94.0233	144.7777	206.8816	257.1516	266.5649	252.2992	213.0137	165.9726	108.2380	62.9986	43.5449	(83)
Total gains	598.4061	655.9654	680.9020	724.8942	748.0149	737.4491	704.3231	665.8532	633.4100	593.9341	579.2545	578.7265	(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	61.9323	62.1208	62.3067	63.1948	63.3637	64.1624	64.1624	64.3125	63.8524	63.3637	63.0228	62.6703	
alpha	5.1288	5.1414	5.1538	5.2130	5.2242	5.2775	5.2775	5.2875	5.2568	5.2242	5.2015	5.1780	
util living area	0.9746	0.9580	0.9298	0.8483	0.7067	0.5153	0.3756	0.4135	0.6331	0.8663	0.9530	0.9779	(86)
MIT	20.1093	20.2747	20.4815	20.7547	20.9230	20.9880	20.9981	20.9969	20.9663	20.7652	20.4145	20.0856	(87)
Th 2	20.3219	20.3238	20.3257	20.3346	20.3363	20.3440	20.3440	20.3455	20.3410	20.3363	20.3329	20.3294	(88)
util rest of house	0.9701	0.9508	0.9177	0.8244	0.6676	0.4653	0.3202	0.3557	0.5807	0.8400	0.9438	0.9739	(89)
MIT 2	19.2774	19.4860	19.7441	20.0782	20.2656	20.3354	20.3431	20.3438	20.3146	20.0971	19.6703	19.2534	(90)
Living area fraction									fLA = Living area / (4) =			0.1833	(91)
MIT	19.4299	19.6305	19.8792	20.2022	20.3861	20.4550	20.4631	20.4635	20.4341	20.2195	19.8066	19.4059	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4299	19.6305	19.8792	20.2022	20.3861	20.4550	20.4631	20.4635	20.4341	20.2195	19.8066	19.4059	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9419	0.9086	0.8192	0.6706	0.4739	0.3303	0.3662	0.5884	0.8349	0.9352	0.9671	(94)
Useful gains	576.0493	617.8786	618.6381	593.8550	501.6340	349.4781	232.6523	243.8500	372.6696	495.8951	541.6920	559.6829	(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	945.8421	918.0792	831.3732	692.4376	530.7435	353.3029	233.1084	244.6281	384.0649	587.7771	780.6079	939.3974	(97)
Space heating kWh	275.1258	201.7348	158.2749	70.9795	21.6575	0.0000	0.0000	0.0000	0.0000	68.3601	172.0194	282.5076	(98a)
Space heating requirement - total per year (kWh/year)												1250.6596	
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	275.1258	201.7348	158.2749	70.9795	21.6575	0.0000	0.0000	0.0000	0.0000	68.3601	172.0194	282.5076	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1250.6596	
Space heating per m2											(98c) / (4) =	14.4335	(99)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	275.1258	201.7348	158.2749	70.9795	21.6575	0.0000	0.0000	0.0000	0.0000	68.3601	172.0194	282.5076	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	297.7552	218.3277	171.2932	76.8176	23.4388	0.0000	0.0000	0.0000	0.0000	73.9828	186.1682	305.7441	(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	213.5099	188.7852	200.9623	178.2079	173.6565	157.5135	156.4458	162.2367	163.5010	181.0283	190.8283	211.4265	(64)
Efficiency of water heater												80.3000	(216)
(217)m	84.9258	84.5239	83.8749	82.5754	81.1707	80.3000	80.3000	80.3000	80.3000	82.4873	84.1597	85.0032	(217)

Fuel for water heating, kWh/month												
	251.4078	223.3512	239.5977	215.8124	213.9399	196.1563	194.8267	202.0382	203.6127	219.4620	226.7454	248.7277 (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	29.4658	23.6386	21.2839	15.5935	12.0449	9.8408	10.9877	14.2823	18.5513	24.3403	27.4923	30.2848 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-29.2327	-42.3953	-62.6413	-72.4344	-79.8018	-75.0804	-74.1729	-69.2220	-60.7177	-49.4108	-32.5628	-25.1379 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-13.0582	-27.8214	-55.9650	-85.0384	-113.4088	-114.3172	-112.9590	-95.1756	-69.1587	-40.0893	-17.5312	-10.2985 (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	1353.5277 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.3000
Water heating fuel used	2635.6779 (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)	237.8060 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1427.6311 (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	2885.3805 (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	1353.5277	0.2100	284.2408	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2635.6779	0.2100	553.4924	(264)
Space and water heating			837.7332	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	237.8060	0.1443	34.3228	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-672.8099	0.1340	-90.1618	
PV Unit electricity exported	-754.8212	0.1256	-94.7725	
Total			-184.9343	(269)
Total CO2, kg/year			699.0509	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.0700	(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	1353.5277	1.1300	1529.4863	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2635.6779	1.1300	2978.3161	(278)
Space and water heating			4507.8024	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	237.8060	1.5338	364.7548	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-672.8099	1.4952	-1006.0110	
PV Unit electricity exported	-754.8212	0.4609	-347.8679	
Total			-1353.8789	(283)
Total Primary energy kWh/year			3648.7791	(286)
Target Primary Energy Rate (TPER)			42.1100	(287)

Block Compliance

Block Reference	PR10986 - 114 Cowley Road	**Issued on Date**	27/09/2023
Block Name			
Calculation Type	New Build (As Designed)		
Assessor Details	Mr. Iraj Maghounaki	**Assessor ID**	V571-0001
Client			

Block Compliance Report - DER

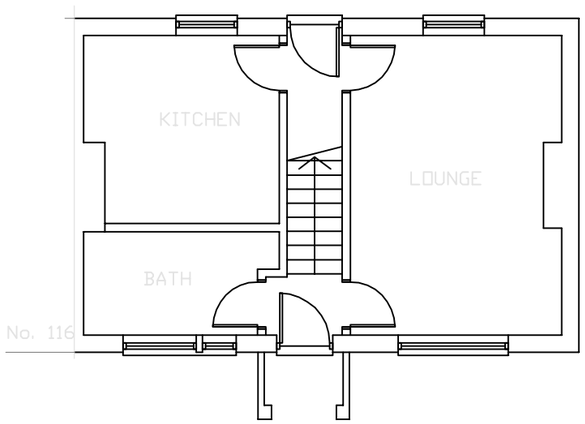
Block Reference: PR10986 - 114 Cowley Road	**Block Name:**			
Property-Assessment Reference	**Floor area (m^2)**	**DER ($kgCO_2/m^2$)**	**TER ($kgCO_2/m^2$)**	**% DER/TER**
PR10986 - Flat 1 - 001 - Be Green	42.46	6.00	15.63	61.61 %
PR10986 - Flat 2 - 001 - Be Green	86.65	6.37	8.07	21.07 %
Totals:	129.11	12.37	23.70	
Average DER = 6.25 $kgCO_2/m^2$	**% DER/TER**	PASS		
Average TER = 10.56 $kgCO_2/m^2$	40.81 %			

Block Compliance Report - DFEE

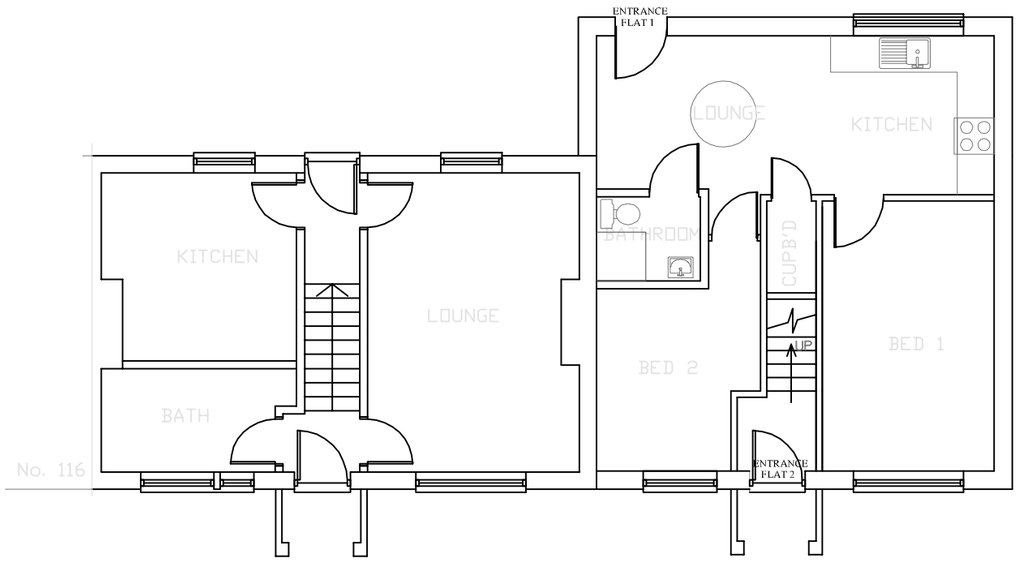
Block Reference: PR10986 - 114 Cowley Road	**Block Name:**			
Property-Assessment Reference	**Floor area (m^2)**	**DFEE ($kWh/m^2/yr$)**	**TFEE ($kWh/m^2/yr$)**	**% DFEE/TFEE**
PR10986 - Flat 1 - 001 - Be Green	42.46	33.28	39.61	15.98 %
PR10986 - Flat 2 - 001 - Be Green	86.65	17.48	18.36	4.79 %
Totals:	129.11	50.76	57.97	
Average DFEE = 22.68 $kgCO_2/m^2$	**% DFEE/TFEE**	PASS		
Average TFEE = 25.35 $kgCO_2/m^2$	10.54 %			

Block Compliance Report - DPER

Block Reference: PR10986 - 114 Cowley Road	**Block Name:**			
Property-Assessment Reference	**Floor area (m^2)**	**DPER ($kWh/m^2/yr$)**	**TPER ($kWh/m^2/yr$)**	**% DPER/TPER**
PR10986 - Flat 1 - 001 - Be Green	42.46	63.63	83.16	23.48 %
PR10986 - Flat 2 - 001 - Be Green	86.65	33.48	42.11	20.49 %
Totals:	129.11	97.11	125.27	
Average DPER = 43.40 $kgCO_2/m^2$	**% DPER/TPER**	PASS		
Average TPER = 55.61 $kgCO_2/m^2$	21.96 %			



EXISTING GROUND FLOOR



PROPOSED GROUND FLOOR

SCALE BAR 1:100

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5. ALL DIMENSIONS ARE IN mm

IBJ Infinite Building Journey Architecture. Structure. Survey.

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DRAWN BY : B.J

DESIGNED BY : B.J

REVISION :F

PROJECT : 114 Cowley Road Littlemore, Oxford OX4 3TJ.

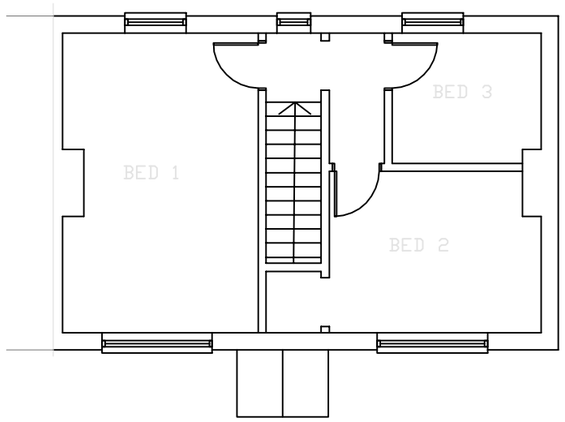
TITLE : PROPOSED NEW BUILD SIDE EXTENSION TO 2NO FLATS

DRAWING NO : BJ/2023/018/01

DATE : 05/09/2023

SCALE : 1:100

ORG.SIZE : A3



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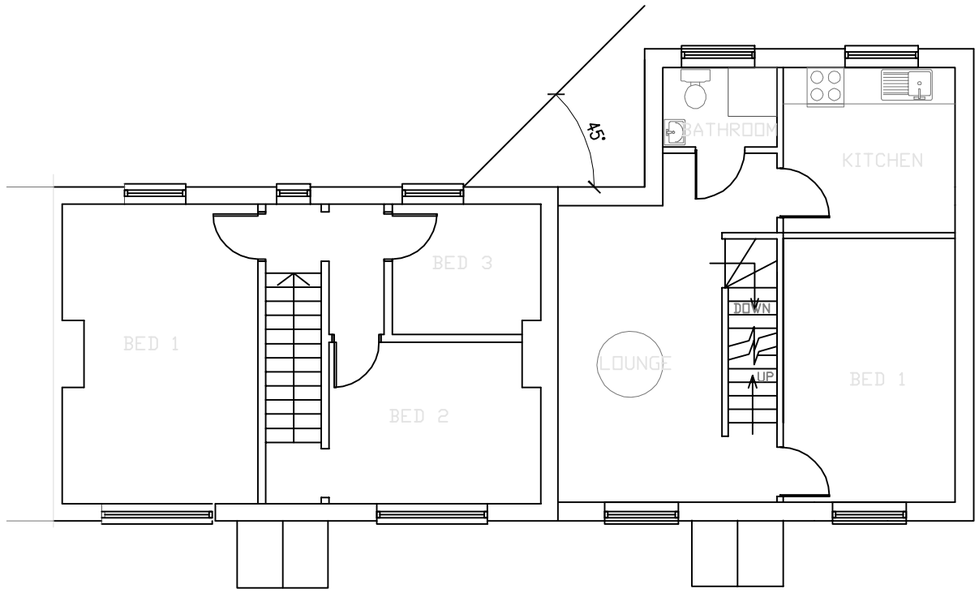

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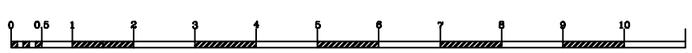

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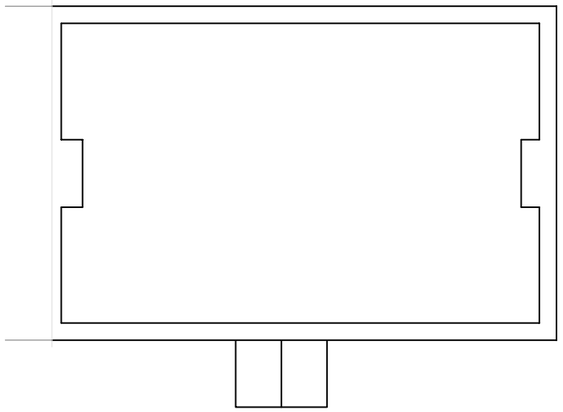
PROJECT : 114 Cowley Road Littlemore, Oxford OX4 3TJ.		TITLE : PROPOSED NEW BUILD SIDE EXTENSION TO 2NO FLATS	DRAWING NO : BJ/2023/018/02 DATE : 05/09/2023	SCALE : 1:100 ORG.SIZE : A3



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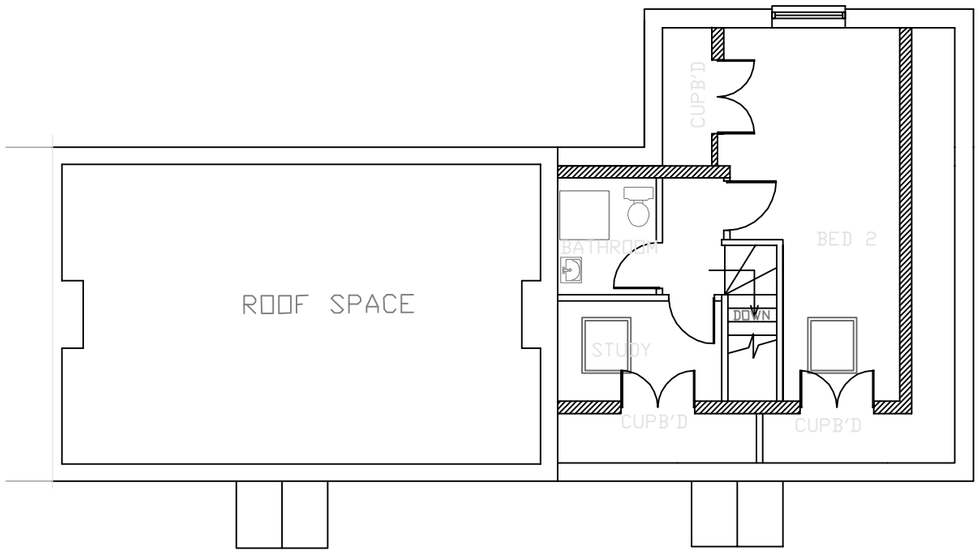

PROPOSED LOFT FLOOR

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TITLE : PROPOSED NEW BUILD SIDE EXTENSION TO 2NO FLATS

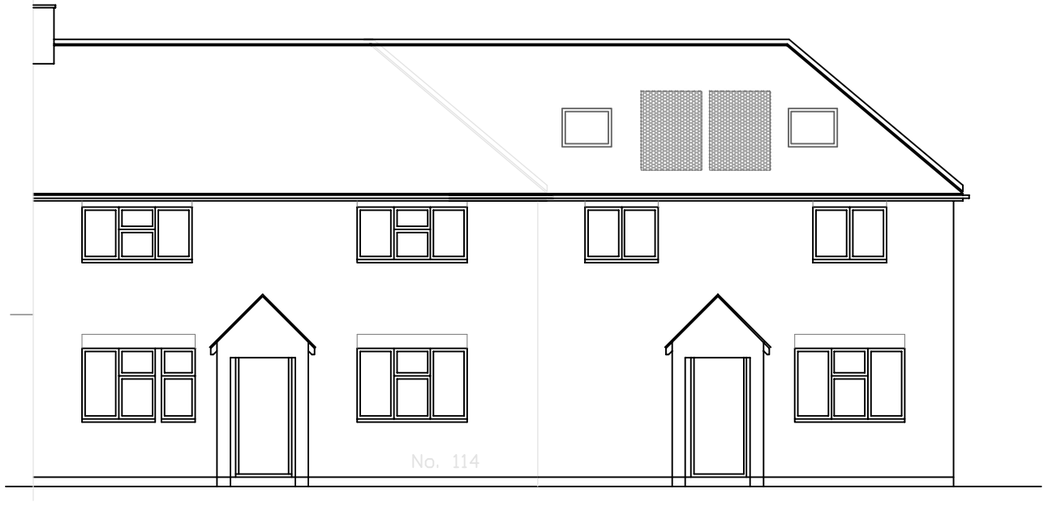
DRAWING NO : BJ/2023/018/03

DATE : 05/09/2023

SCALE : 1:100

ORG.SIZE : A3

EXISTING FRONT ELEVATION



PROPOSED FRONT ELEVATION

0 0.5 1 2 3 4 5 6 7 8 9 10

SCALE BAR 1:100

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TITLE : PROPOSED NEW BUILD SIDE EXTENSION TO 2NO FLATS

DRAWING NO : BJ/2023/018/05

DATE : 05/09/2023

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EXISTING REAR ELEVATION

PROPOSED REAR ELEVATION

SCALE BAR 1:100

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TITLE : PROPOSED NEW BUILD SIDE EXTENSION TO 2NO FLATS

DRAWING NO : BJ/2023/018/06

DATE : 05/09/2023

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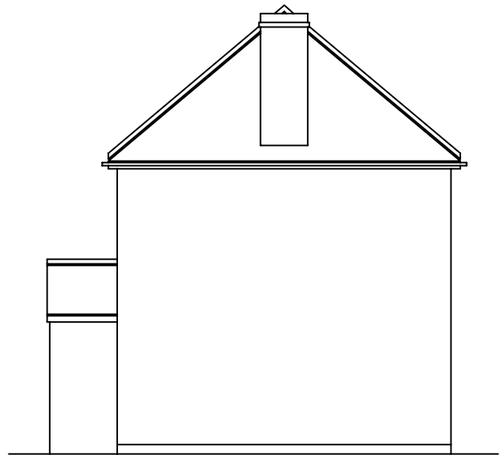
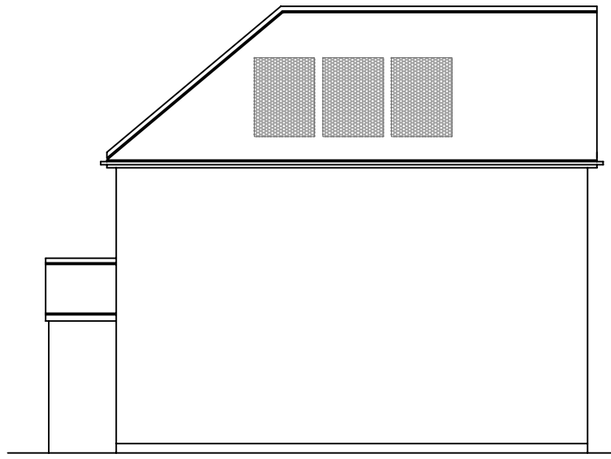


EXISTING SIDE(RHS) ELEVATION



PROPOSED SIDE(RHS) ELEVATION

SCALE BAR 1:100

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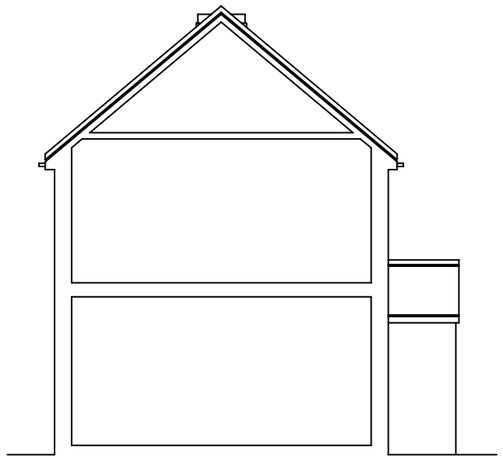
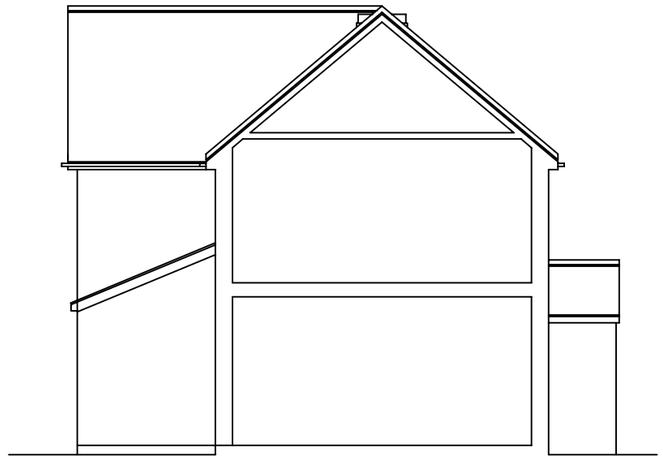
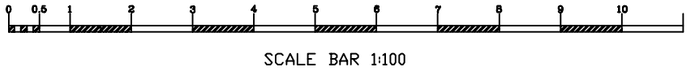


EXISTING SIDE(LHS) ELEVATION



PROPOSED SIDE(LHS) ELEVATION



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PROJECT : 114 Cowley Road, Littlemore, Oxford OX4 3TJ.

TITLE : PROPOSED NEW BUILD SIDE EXTENSION TO 2NO FLATS

DRAWING NO : BJ/2023/018/08
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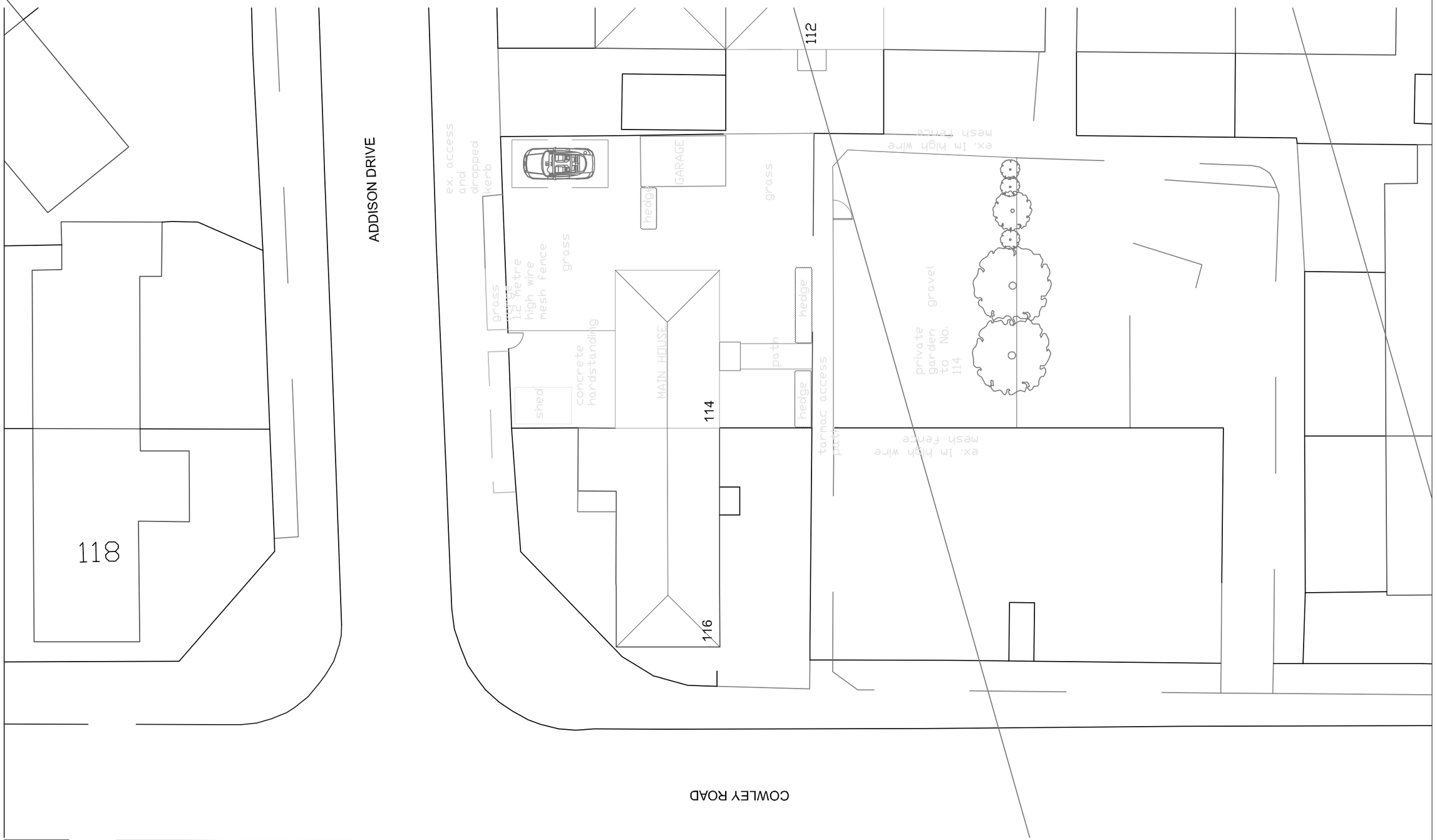

EXISTING SITE BLOCK PLAN

SCALE BAR 1:200

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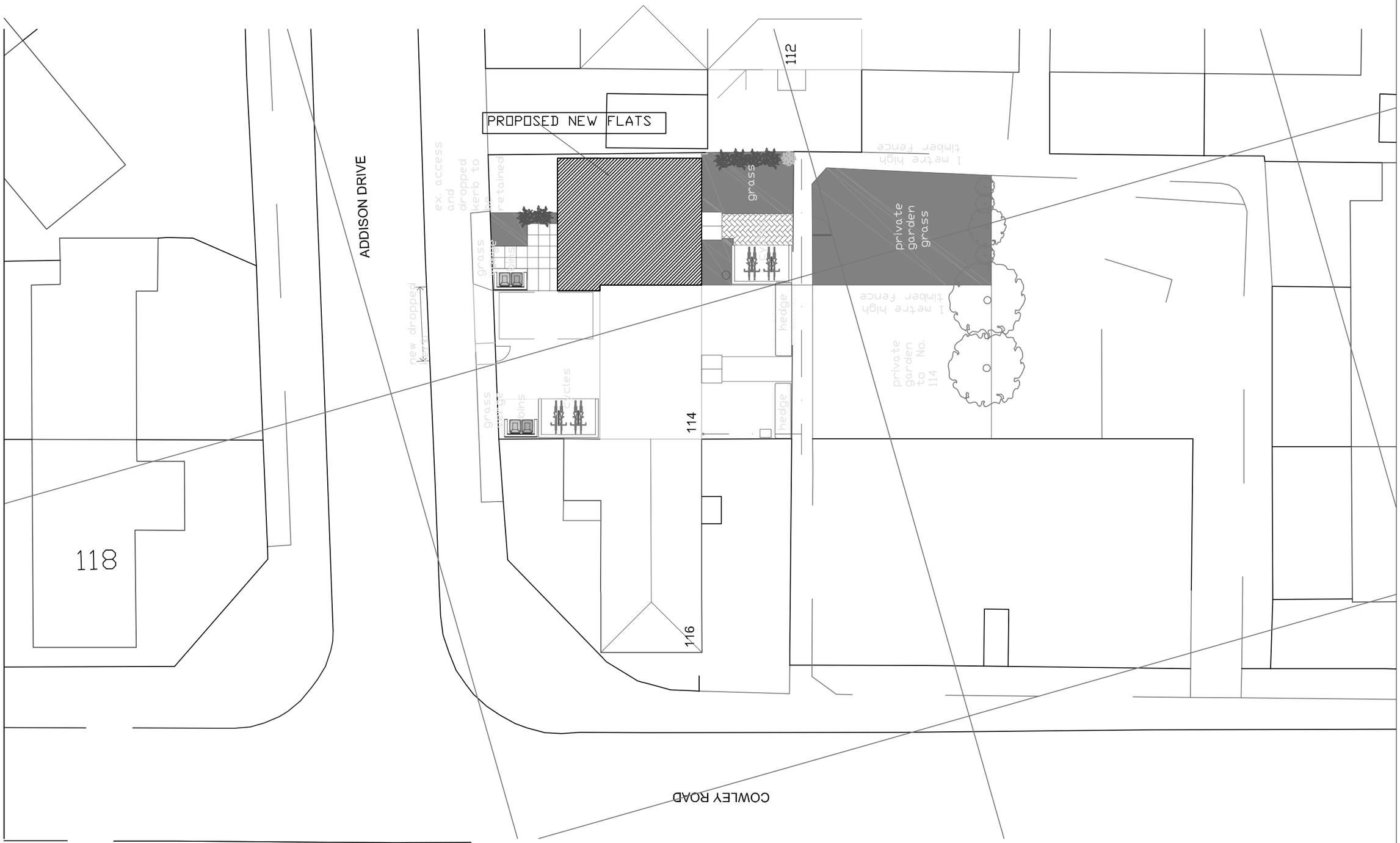

PROPOSED SITE BLOCK PLAN

SCALE BAR 1:200

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REVISION :F

PROJECT : 114 Cowley Road Littlemore, Oxford OX4 3TJ.

TITLE : PROPOSED NEW BUILD SIDE EXTENSION TO 2NO FLATS

DRAWING NO : BJ/2023/018/09
DATE : 05/09/2023

SCALE : 1:200
ORG.SIZE : A3

breglobal

Job no:	PR10986
Date:	27/09/2023
Assessor name:	Iraj Maghounaki
Registration no:	BRE400012
Development name:	114 Cowley Road, Littemore, Oxford, Oxfordshire, OX4 3TJ

PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 70% (maximum)

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS - (BASIC CALCULATOR)

	House Type:	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7		Type 8		Type 9		Type 10	
	Description:	Flat 1		Flat 2																	
Installation Type	Unit of measure	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day
Is a dual or single flush WC specified?		Dual		Dual																	
WC	Full flush volume	6	8.76	6	8.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Part flush volume	3	8.88	3	8.88		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	6	11.06	6	11.06		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Are both a Bath & Shower Present?		Shower only		Shower only																	
Bath	Capacity to overflow		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Shower	Flow rate (litres / minute)	9	50.40	9	50.40		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Kitchen sink taps	Flow rate (litres / minute)	6	13.00	6	13.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a washing machine been specified?		No		No																	
Washing Machine	Litres / kg	7	17.16	7	17.16		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a dishwasher been specified?		No		No																	
Dishwasher	Litres / place setting	0.9	4.50	0.9	4.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a waste disposal unit been specified?		No	0.00	No	0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Water Softener	Litres / person / day		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Calculated Use		113.8		113.8		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Normalisation factor		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91
Code for Sustainable Homes	Total Consumption		103.5		103.5		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Mandatory level		Level 3/4		Level 3/4		-		-		-		-		-		-		-		-
Building Regulations 17.K	External use		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0
	Total Consumption		108.5		108.5		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	17.K Compliance?		Yes		Yes		-		-		-		-		-		-		-		-